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TREES FOR WIRELESS TELEGRAPHY.

An ingenious suggestion was made recently by Major G. O. Squier, of the signal corps of the United States army, which, if it proves practicable, will be of great service to the signal corps. Major Squier says that as a living organism may form a part of an electrical circuit, it is possible to utilize a tree as the aerial of a wireless telegraph system. Connections should be made near the ground and where the branches begin to spread, by the simple method of driving in two iron nails to which the receiving device is attached. If the plan works well in practice there will always be suitable aerials for army use, except in a very barren country. Probably a tree is not as efficient as a metallic wire properly suspended, but as the distances to be covered in army signaling will never be great, this is a small matter. A more important point is the deduction that if a tree can be used in this way with good results, it would seem to follow that an intervening forest adds to the difficulty of transmitting messages over land. It may, in some cases, make the operation of a wireless system, under such conditions, practically impossible.

TELEPHONE AND TELEGRAPH STATISTICS.

A recent bulletin issued by the Department of Commerce and Labor, Washington, D. C., covering the telephone and telegraph systems of the country, forms the first complete summary of these industries which has been made in this country. The year covered is 1902, and this should be remembered when considering the total development, for the growth during the past two years has been large.

A study of the tables contained in this bulletin reveals some very interesting conditions. In the first place, there were over sixteen times as many telephone systems in operation as there were telegraph systems. This, of course, is only to be expected when one considers the different fields which the two systems of communication occupy. However, the growth of the telephone has been far more rapid than that of the telegraph, for the former, although only about half the age of the telegraph, has over three and one-half times as much wire, and the par value of the capital stock and bonds outstanding is more than twice as great. The telephone gave employment to over seventy per cent of the wage-earners, paid over sixty-five per cent of the wages, and received sixty-eight per cent of the total revenues, paying nearly the same percentage of the total expenses reported for both systems.

Under the head of telephone service, three systems are recognized in this bulletin: commercial systems, including all systems operated by individuals, firms or corporations for revenue; mutual systems, including systems operated through mutual arrangement between the persons deriving benefit from the service, primarily the benefit of the owners; third, independent farmer or rural lines having no regular exchange or central office. The first of these was by far the most important, and during the year covered by the report had in operation nearly ninety-four per cent of the total number of telephones, while the mutual systems had in operation a little less than four per cent, and the independent or rural lines but a little over two per cent. Taking the total population of the continental United States for the year, as estimated by the Bureau of Census, it is found that there was an average of one telephone to every thirty-three inhabitants.

One of the most interesting tables contained in this bulletin is that giving what we may call the geographical development of the telephone. This shows a very great variation, some localities apparently having an excessive development, while in others there would appear to be ample room for growth. For instance, the average population per telephone, as indicated in this table, was thirty-four; the average number of messages per capita was sixty-five, while the average number of messages per telephone for the year was 2,190. Running over the list of states

it is noticed that in certain of them the population per telephone is much above the average. The number of messages per capita is below the average, but the number of messages per telephone is greatly in excess; and it is noticed also that these exceptional conditions come in the same geographical location. For instance, Alabama has less than three-quarters of a telephone for every 100 inhabitants (the average for the country is 2.95). The number of messages per capita is only twenty-four, yet the number of messages per telephone is 3,279. For Georgia the corresponding figures are 1.11 telephones per 100 inhabitants, forty-two messages per capita, and messages per telephone, 3,774. In Louisiana there were only 1.22 telephones per 100 inhabitants. The messages per capita were forty-seven, and per telephone, 3,888. For Mississippi the number of telephones was only 0.95 per 100 inhabitants; the messages per capita, thirty-eight, and the number of messages per telephone, 4,009. Tennessee gives the following figures: 1.75 telephones per 100 inhabitants; sixty-two messages per capita, and 3,557 messages per telephone. This shows that there was a great use of the telephone facilities at that time existing in the South, even though the people did not use the telephone individually as much as in other sections. They suggest that this offers a good field for telephone development.

Another striking group of states is that of the Middle West, including Indiana, Michigan, Ohio, Illinois and Iowa. In these states the messages per capita were much above the average. The number of telephones per 100 inhabitants was above the average, yet in every case the number of messages per telephone does not vary much from the average. Evidently these states have acquired the telephone habit to a marked degree. The large number of independent companies in these states doubtless has some influence on the averages, particularly where it is necessary for one person to have two instruments.

Telephone development in the states of the Far West shows some interesting features. California, for instance, leads all the states in the number of instruments per 100 inhabitants, this being 7.15—over twice the average. The people of California also use the telephone freely, but there are so many instruments there that they are used less than the average number of times. Practically the same conditions obtained in Oregon and Washington, although to a less degree. In these states the independent companies are few in number, which makes the development all the more remarkable.

These averages may be somewhat affected by the large cities, but a table giving the same statistics for the principal cities of the country shows that, in general, the averages for these do not vary much from those for the entire country. In New York, for instance, there are less than the average number of telephones per 100 inhabitants, this being only 2.56. Chicago, Philadelphia, St. Louis and Boston show a somewhat greater number of instruments, notably Boston, where there are about five and one-quarter telephones for every 100 inhabitants. The conditions in San Francisco are analogous to those of California in general, but are even more marked, for there are in that city over eleven telephones per 100 inhabitants—more than three times the average number.

The conditions in New York state show that although there are more telephones per 100 inhabitants than the average, the messages per telephone and per capita are less than the average. It is interesting to note that, taking the state as a whole, the telephone development outside the city of New York is greater than in the city, a condition which might not have been expected.

New Jersey shows an interesting state of affairs. The number of telephones per 100 inhabitants was only 2.5; the number of messages per capita, only twenty-nine, and per telephone, only 1,127. In other words, New Jersey is below the average on all three counts. The telephones there are used less than in any other state. Possibly this may be accounted for by the proximity of two large cities—New York on the east, and Philadelphia on the west.

These conditions, of course, refer only to the year covered by the statistics, and conditions to-day, in some sections at least, will be different. The smallest number of messages per capita is seventeen, for South Carolina, and the highest number is 131, for Ohio. Six states show an average of over 100 messages. In addition to South Carolina, the only other state and territory showing an average of less than twenty messages per capita are North Carolina and Indian Territory. It would seem, in general, that where there are few telephones per 100 inhabitants there are fewer messages per capita, but more messages per telephone. Of course, the use of the telephone will vary somewhat with the character of the industries of a state.

THE COST OF STREET LIGHTING.

At the enquiry held last week by Comptroller Grout, to determine whether the price charged the city of New York for arc lights for street lighting is excessive, some important points were brought out. It was shown that the figures of fifty-four dollars and fifty-six dollars per arc lamp per year stated to be the cost to the city of Chicago (Ill.) for operating lights from its municipal plant did not include any allowance for taxes, depreciation or interest on the investment. Obviously, it is unfair to compare such figures with prices charged by a private company.

Another point which was brought out, and which does not seem to have received sufficient notice, was the statement that the city of Chicago has now contracted with a local electrical company for 600 street arc lights at $103 per year. This is for overhead service. It has further contracted for such additional street lights as may be necessary, and where these are supplied by underground conductors, the price per year is $136. Comparing these figures with the price offered by the New York company, of $130 per lamp per year for overhead service, and $146 for underground service, the difference is considerably less than the advocates of municipal lighting have held. It should also be remembered that the conditions in New York differ from those in Chicago, which might easily explain the slightly increased cost of lights for the former city.

THE CANDLE-POWER OF SEARCHLIGHTS AND FLASHLIGHTS.

The daily papers announce that St. Catherine's Lighthouse, Isle of Wight, has been fitted with a flashlight, the brilliancy of which is estimated to be 15,000,000 candle-power. On nights when the atmosphere is favorable its beam is probably visible from the French coast. It is said that this light replaces one of 3,000,000 candle-power.

The practice of rating searchlights and other lights in which the distribution of light is altered by means of reflectors or lenses should be abandoned, since it means nothing at all, although it may convey the impression that a certain light is exceedingly powerful or that its light may be seen at a very great distance. Photometric measurements are based upon the law that the intensity of illumination at any point varies inversely as the square of its distance from the source of light, and this law is based upon the assumption that the light is allowed to distribute itself freely in all directions. Where the distribution is altered in any way, the candle-power rating should be accompanied by an explanation of how the measurement was taken.

With searchlights or other lights intended to throw a beam for a great distance by means of lenses or reflectors, practically all the light from the arc is made to pass out from the lamp in one direction. This beam is made up of nearly parallel rays, and under such conditions, the intensity of illumination does not decrease as the inverse square law, as the measurement is made further and further from the lamp. For instance, should the intensity be measured at, say, 100 feet away, and be found to be 1,000,000 candle-power, and another measurement be made 200 feet away, there will be little difference in the intensity of illumination at the new point, and hence a rating of 4,000,000 candle-power would be indicated. The absurdity of such a system of rating is evident. Supposing that the rating usually given is modified by stating the distance at which the measurement has been made, the result would still be unsatisfactory because by varying the size of the beam of light the intensity of illumination can also be varied. To be completely accurate, such a measurement should give not only the candle-power rating and the distance at which the determination has been made, but also the area of the cross-section of the beam.

A somewhat similar condition of affairs existed in the early days of arc lighting, and one still hears of 2,000-candle-power arc lamps, though the expression is generally modified by the addition of the word "nominal." As a matter of fact, no commercial arc lamp gives 2,000 candle-power. In fact, it does not give 2,000 candle-power in any one direction. One story of the manner in which this old rating came to be accepted is to the effect that an enthusiastic salesman was told that the maximum candle-power given by his lamps in any one direction was about 500 candles. If, then, he argued, his lamp would be placed upon a street corner, it would give 500 candles down each street, and hence was a 2,000-candle-power lamp. On the same basis, those lamps which were not placed at intersecting streets should have been rated only at 1,000 candles, and those placed where a greater number of streets intersected should have been rated higher. This rating was dropped some time ago, and the lamps are now rated according to their energy consumption; which is satisfactory in one way, but it does not fix rigidly the amount of light which will be obtained from the lamp, since this varies with the quality of the carbon used. A soft carbon gives a whiter light, and generally more light, than a hard carbon, though the former is consumed more rapidly than the latter. However, since this matter of the carbons is beyond the control of the maker of the lamp, the rating of the lamp itself in watts is sufficient, and it would seem better to adopt a similar method of rating searchlights and lights intended for lighthouses. If desirable, to this rating there might be added a statement of the distance which the beam will carry and be effective.

THE AUTOMOBILE SHOWS.

The opening of the two important automobile expositions in New York city last week has concentrated attention upon the state of the art in the design of the horseless vehicle. The fifth annual automobile show, opening at Madison Square Garden on the evening of January 14, brought together probably the most remarkable display of automobiles the world has ever seen. The recent automobile show at Paris is described as magnificent, but those who have been there and know what is assembled in New York city, do not hesitate to give first place to the latter. The firms selling imported machines engaged separate space in the Herald Square Music Hall, and under the designation of the "Importers' Automobile Salon," on January 11, presented to the public a fine display of vehicles.

A notable feature of the machines on exhibition is the extent to which care has been exercised to produce the most brilliant and striking finish. In the underbody, in the coach, the upholstering, the hood, the brass and nickel parts—all have been finished and refinished until it seems as though perfection were near at hand. And in this direction the foreign makers are fast losing the vantage ground of supremacy. Not many years ago it was the boast of the foreign automobile designer that no matter what might be done in power the American maker could not approach them in lines of design or in beauty of finish. As the matter stands to-day, however, as far as mere appearance goes, the carriages of both foreign and domestic makers stand about equal in popularity.

The city block upon which Madison Square Garden stands has been fringed with automobiles during the week of the show The gasoline machine has, of course, predominated, and this has served to accentuate its objectionable characteristics. The streets resound with the noisy cough of the exhaust and the atmosphere reeks with the vile odor of the burned gases. Notwithstanding these features, the gasoline machine easily outnumbers both the steamer and the electric.

There is, however, no diminution in the ranks of those who prefer the electric carriage. This machine is beyond doubt the ideal, in point of view of appearance, noiseless running, and ease of handling. The battery makers are improving their product, and getting greater mileages per pound of cell. As charging facilities are improved and supplying stations become more numerous and less widely separated, the electric vehicle must increase in popularity.

The showing at the exhibitions in electrics was very satisfactory and was an indication of the high degree of excellence to which the American maker has aspired.

TELEPHONE LINE ENGINEERING.[1]

BY C. J. H. WOODBURY.

The wonders of the telephone as the most subtle of physical apparatus, yet so simple as to be the only electric device operated without skill, an invention without precedent which has also escaped improvement, has worthily been the theme of frequent portrayal, which has also been devoted to that concentration of applied science upon the switchboard and the transmitter, each of them essential adjuncts in the development of the telephone system.

The salient characteristic which justifies all commercial applications of electricity, except those of industrial chemistry, is that it overcomes the impediment of distance, and it is essential that the conductors spanning these long extents, free from direct supervision, shall be as permanent as possible in order to maintain conditions of constant service.

The amount of capital amassed in the approximately 4,000,000 miles of line construction necessary to connect together in a unity the subscribers of the Bell telephone system is of itself a warranty as to the importance of the subject; while the rapid depreciation to which most of this property is subjected requires both technical skill and business judgment to decide upon the most judicious methods of construction of this vast plant, amid varying circumstances of natural conditions and commercial use, in order to reach the most economical point of investment.

Analyze the general problem as one may, and standardize the general methods to cover a wide range of circumstances, yet there are exigencies and varying conditions which require the exercise of that type of constructive engineering which "does things."

The application of mathematical principles is essential to any constructive work which is not merely a repetition of precedents, and the ordinary precedents of safe construction have been established upon the wrecks of past failures perhaps for generations agone.

The increase of every commercial application of electricity to meet the demands to supply service to patrons has been so great that an essential portion of every problem in constructive electricity must take into consideration provisions for future growth as well as the inevitable depreciation.

POLES.

Although forty-five per cent of the wires are on poles, the total extent of the pole lines exceeds the length of the underground conduits, as the latter are used only in cities where the conduits contain a greater number of lines to reach the concentration of patronage. The extent of the pole lines is shown by the fact that in the Bell telephone system there are approximately 6,300,000 poles, and about 1,000,000 are required annually for replacement and for extension of lines.

The stresses to which a telephone pole is subject are the result of many and variable combinations of live and dead loads upon a beam fixed at one end and loaded near the other end. There is scarcely anything in engineering construction so actively the subject of depreciating conditions. The top is exposed to the weather, and the important section near the surface of the ground is the portion most energetically attacked by decay. The wood is assailed by animal life, whether it be gnawing by horses in town, or the perforation by woodpeckers in remote districts. Poles in wild countries are bitten by bears in search of bees, whose humming is imitated by the vibration of wires, and it is said that in India the tigers use the poles to sharpen their claws upon after the manner of their second cousins, the domestic cat, but with so much more vigor that the poles become weakened.

Antiseptic methods for treating poles as a preventive against decay and the attacks of insects have not been so general in the United States as in Europe, as the relatively sparse settlement and distances between cities having the elaborate plant necessary for treatment would make the transportation of the poles for treatment and back to the sites where they are to be used a prohibitive expense.

However, poles treated by creosoting have been used in this country wherever transportation conditions between the sawmill, the treating plant and the sites where they are to be used will permit.

A pole line is not designed merely on the basis of the stresses to which the pole is subjected in drawing the wires to the necessary tension, for in most northern climates the sleet will at times form upon the wires until they become icy cylinders perhaps three inches in diameter, and the problem is not that of the mere added weight, for the force of the wind blowing against this icy sail applies a greater horizontal load, which combines with gravity and produces a resultant force in a diagonal direction, greater than either of the contributing units.

An ice-laden line swayed by the wind may be successfully resisted by the poles until the oscillations of the pendulum reach a synchronism with that of the vibration of some pole on the line which responds in like manner to the cumulative impact across the direction of the line, until it breaks this individual pole. Then adjacent poles are relieved of the pull on one side, and the excessive unbalanced stress breaks them.

The most undesirable occurrences in connection with the wreckage of aerial lines are the disturbances resulting from the contacts of different electrical systems with each other, when the various lines are so near as to collide, when one or both break.

The remedy against the liability of such crosses is the simple one stated by a judge of a United States court, in which the decree was given that the distance between the high and low potential lines should be equal to that of the highest pole, so that in the event of the falling of a pole the wires would come short of reaching the other line. In many instances congestion of electric service and narrow streets prevent any such wide separation, and it becomes necessary to take every precaution for substantial construction.

It is necessary for such different lines to cross the others' routes, and in such instances provision against collision is made by the use of extra heavy construction, thoroughly bracing and guying the poles, and arranging against overhauling of the lines in case of their breakage; also guarding the wires so that those on the upper line could not fall over the ends of the cross-arms in case of their separation from the points of support.

As high-tension wires are of larger diameter and fewer in number, their poles should be higher at the crossover.

The crossover span should be so short and at such height that in case of breaking next to an insulator, the remaining portion of the span wire should not be long enough to reach to the lower line.

The necessary height of poles, or the impracticability of placing them in such positions as to provide for the short crossover spans, may sometimes render it unfeasible to adopt this construction, and a grill of hard-wood slats placed at frequent intervals across a pair of steel wires or cables between the two spans interposes a screen which prevents a broken wire on the upper span from reaching the lower span.

In some instances, where there are but few wires in each line they are attached to the same pole, and the contact is prevented by a framework carrying guard

[1] Abstract of a paper read before the Franklin Institute, Philadelphia, Pa., January 12, 1905.

wires below the upper line. It is not as a general principle advisable to use a single-pole crossover.

AERIAL WIRES.

The tension on a line suspended between a pair of horizontal supports varies with the sag and is at a minimum when the sag amounts to seven-twentieths of the span, and the tension increases whether the sag is greater or less than this proportion.

For example, with No. 12 hard-drawn copper wire, weighing 173 pounds to the mile, and being 0.104 inch diameter, and having a span of 130 feet, the minimum tension of three pounds would occur if the sag was forty-three feet six inches, while it would slowly augment with increase in the sag, and if nature had furnished a chasm deep enough for the experiment, it would be expected to reach its breaking tension of 550 pounds at a depth of 16,470 feet, or 3.17 miles.

On the other hand, the increase in tension proceeds rapidly as the wire is drawn to approach a straight line, the breaking tension occurring at a sag of one and one-half inches.

As a comparison with this instance of the stresses in a local line, in the case of the No. 8 hard-drawn copper wire, 0.165 inch in diameter and weighing 435 pounds to the mile, as used on long-distance telephone lines, when the span is 150 feet the minimum tension occurs at a dip of fifty-two feet six inches, when it is only eight and three-fourths pounds, and in like manner, as in the foregoing instance, its breaking stress of 1,328 pounds would be reached at the slightly less dip of 16,100 feet, or 3.04 miles, still too great to admit of confirmation by direct experiment; but if the wire was pulled until the sag was 2.2 inches, it would require the breaking load of 1,328 pounds.

It is desirable that the wires should be drawn tight enough to prevent them from swaying against each other; but it is important that they should not be drawn so tight that the contraction during extreme cold weather should cause the wire to break.

HARD-DRAWN COPPER WIRE.

The electrical advantages of copper over iron could not be utilized for aerial wires, because commercial copper has so little resilience that it will continually stretch under its own weight and become attenuated to an extent that it will break, until Thomas B. Doolittle produced the hard-drawn copper wire which is now in universal use on aerial lines. The treatment consists in omitting the annealing processes during the latter portion of drawing the wire, but it deviates from the usual method by attenuating the wire by smaller gradations at the latter die-plates. Its electrical conductivity is practically the same as that of commercial wire drawn from the same ingots, the slight increase being due to the change in the molecular condition of hard copper.

The relative cost of iron and copper wire is not a measure of the comparable expense of such lines in actual service, as copper does not have an oxide of high resistance, and its life has not yet been determined. The value of copper scrap from wrecked or reconstructed lines is about two cents a pound less than that of new wire, while galvanized iron line wire costs about four cents a pound, and when taken down is of no value and is generally thrown upon a dump.

The rusting of iron wire at the joints adds materially to the resistance of the line.

LONG SPANS.

Where lines traverse mountainous districts or water-courses it is frequently necessary to build spans of great length, using either one of the special bronzes or steel wire for the purpose.

Long spans are frequently strung in cases of emergency, as when the flood of June 2, 1903, carried away the bridge crossing the Kaw river at Kansas City, Mo., and also the wires attached to it, a span of wires 900 feet in length was immediately suspended between high spars erected on either bank.

The most spectacular work in line construction has been done among the mountain ranges of the West.

Lines have been built against the face of cliffs bordering deep canyons, where it was necessary to incline the poles so that the tops carrying the wires overhang the deep abyss, in order to avoid icicles and avalanches falling down the precipice.

In building telephone lines through this mountainous country, a couple of poles are slung like panniers on the sides of two or three mules tandem, and these sure-footed animals will carry them along the rough trails.

The wire is wound in great lengths in connecting coils, which are placed on the sides of the saddles of a train of pack mules, which are thus connected on one side by wire from coil to coil, around the front of the foremost mule and thence back along the other side of the train.

By removing the last pair of coils and unreeling, and thence in turn to the next coil, the pair of wires for a metallic circuit can be laid down along a route.

The Mosquito pass, near Leadville, Col., was crossed at an elevation of 13,130 feet by a line of poles which were set only fifteen feet apart at the more exposed places, but even this construction did not resist the storms of winter.

Telephone lines were afterward maintained through this Alpine exposure by an expedient as far out of the ordinary as the celebrated venture of Lord Timothy Dexter in sending warming-pans to the West Indies, and that was by replacing the line of poles by submarine cable carried to this elevated site in continuous coils, as in the case of wire transportation over the mountain trails upon a train of mules, and laid in trenches among the rocks to avoid any disturbances from avalanches.

There have been instances when it was necessary to make expeditions to these altitudes in severe weather to make repairs.

The rough valleys through which the routes pass are picturesque in summer, but in winter the snow accumulates to such depths that linemen attend to their duties on snow-shoes, reaching the lines on twenty-five-foot poles as if they were wire fences.

Imogene Basin, Col., at an elevation of 13,700 feet, is crossed by a span of 950 feet, which inclines at an angle of twenty-seven degrees. Near Telluride and the Tomboy mines, ravines are crossed by similar long spans. A surveying party, arranging for the extension of some of these lines, found the snow to be twenty feet deep in these basins in the middle of July, while avalanches had rolled down opposite sides of a valley, leaving a narrow pass bordered by snow and ice one hundred feet in height.

These lines running from the valleys up to great elevations on the mountains are charged with atmospheric electricity, particularly in winter, which is discharged to earth by bridging retardation coils across the lines and grounding the central part of the coils.

The surveying party noted that these disruptive discharges of static electricity occurred about sixteen times a second, producing a continuous sound which could be heard by one near to the wires. The mountain appeared to be enveloped by static electricity, the poles and the engineers' transit glowed with St. Elmo's fire, and an irritation was felt at the head and the hair would fly up if the hat was removed.

This electric envelope did not appear to extend to the ground, as one was entirely free from any sensations when lying down, but if, while in such a position, a

hand was raised to about three feet above the ground, a sharp sputtering sound of static electrical discharges would occur.

Useful as the telephone may be in affording facilities for communicating between different portions of a city, there are other methods of reaching one's townspeople—messenger, mail, or, like the leader in a child's game, "send myself" —but there is no equivalent for the question and the answer which can be exchanged between persons fifteen hundred miles apart, their voices reaching each other in less time than if they were conversing across a room; or, to give a concrete example, the time for telephonic transmission over the 1,064 miles between Boston and Chicago is 0.006 second, while the distance that the voice is transmitted through the air in that time is six and one-half feet.

There are many thousands of miles of telephone lines without poles, for the business of lumbering and the wood-pulp industry is conducted over telephone lines traversing the forests from tree to tree through the wilds.

By the use of the telephone the methods of log-driving have been changed for the better. The facility of communication between different gangs along a stream enables the logs to be conveyed without the disturbances caused by jams, which can be prevented by prompt action, and also avoids the destruction of timber, which would otherwise result from the use of dynamite to relieve these jams.

Smaller and more rapid streams, hitherto unsuited for lumbering, have been utilized by the construction of dams, which husband and release the water as may be considered necessary by the men perhaps miles below, who speak through the telephone to those operating the gate at the dam.

One of the most useful applications of the telephone is in connection with the life-saving service, whose telephone lines extend along the shore, and the patrolman carries a small portable telephone which he can connect at fixtures upon the side of frequent poles, and in this manner communicate to the life-saving station for routine report and to summon help in case a vessel is in peril off the shore.

UNDERGROUND CONDUITS.

The number of wires necessary to supply the patronage in cities so far outnumbered the possible capacity of pole lines along the streets that it became necessary to place them underground, and this required the development of the underground conduit and the telephone cable as new arts.

While fifty-five per cent of the telephone exchange wires are underground, yet the great number of wires in these conduits in comparison with those upon poles makes the number of miles of pole lines throughout the country seventy times the length of the streets occupied by underground conduits.

While no other ratio may give an adequate impression of the predominant use of the telephone for communication over long distances, yet in comparison with steam railroad rights of way in the United States the length of Bell telephone pole lines exceeds that of the railway system by over twenty-six per cent.

The first experimenters upon underground systems attempted to make them water-tight, and also insulators, such as a solid mass of asphalt concrete in which wires, frequently without insulation, were imbedded.

The lack of satisfactory results caused the Bell Telephone Company to begin the development of the work under Mr. Joseph P. Davis, chief engineer, on the principle of providing a conduit of substantial construction containing ducts in which the cables could be placed or withdrawn, and relying upon the conduit merely to provide a protection against injury.

Underground conduits have wrought a great change in the housing of the telephone central station plant, as the rigidity of an underground system requires that the distributing centres should be of equivalent permanency, and the telephone plant could not in such cases be subject to the mutations of hired property, but must own the buildings.

Therefore fireproof buildings have been constructed by telephone companies all over the country, until the Bell telephone system owns the greatest number of fireproof buildings of any single interest in the country, and its holdings of buildings and land in cities make it a vast realty enterprise.

If the underground conduits remove conductors from vicissitudes of decay of poles, and exposure to storm and the hazards of foreign currents, yet the underground conduits have their share of mishaps.

Breaks in water pipes or sewers disturb the foundations of these conduits, rain-storms flood them, illuminating gas percolates into them waiting to be ignited by a spark from a horse's shoe at some leak around a manhole cover, or it may be lighted by men going to work in a manhole with a lantern looking for trouble—and finding it.

The superficially attractive proposition of joint conduit systems, particularly in connection with a scheme of municipal conduits for all electric wires, has been attended by serious occurrences.

Crosses among high-tension conductors in cables occur from time to time, and if the wires of signaling systems were exposed in the narrow limits of a manhole, they would be disabled.

In one city where an inclusive conduit was laid by the municipality, the work was fortunately in good hands, and the manholes were built very large, with the cables of various classes placed on supports upon opposite sides of the manholes, and the cables containing high-tension wires were enveloped with split underground tile conduit tied together.

The attempt of a municipality to force a Bell telephone company into an exclusive underground conduit system under circumstances which were considered to expose its cables to hazardous conditions, gave rise to litigation in which the contentions of the telephone company were fully sustained by the supreme court of that state.

CABLES.

The necessity for cables was coincident with the decision that underground conduits must be constructed on the "drawing-in" and not on the "built-in" system, and at about the same time it was foreseen that aerial cables must replace the open wiring in cities wherever there were a great number of local wires, on account of their compactness and greater resistance to storms. For electrical reasons, it is necessary that open wiring must be used for long telephone lines.

The first telephone cables, both aerial and submarine, are believed to have been those used at Philadelphia in 1881, and at that time experimental constructions were being made at Providence, R. I., Brooklyn, N. Y., and Boston, Mass.

In the latter city parallel rubber-covered wires, giving conditions of such great electrostatic capacity that a mile was the utmost limit of telephonic transmission, were tried, but when about a third of a mile was inserted in a telephone line, subscribers complained that their instruments were becoming worn out, as they could barely hear; and the induction between the parallel wires was so great as to transmit cross-talk between the various circuits.

The induction was stopped by placing the wires in twisted pairs, but the prob-

lem of insulation with a low static capacity required long experimentation by many persons. Mr. W. D. Sargent, of Brooklyn, tried paper insulation and found that the static capacity was reduced and the transmission correspondingly improved, which Mr. T. D. Lockwood found to be due to the occluded air among the loosely twisted fibrous paper, and not to the paper as an insulating material.

Mr. John A. Barrett, of New York, was intimately engaged upon experimentation and manufacture of cables, and to him are due many improvements in cable design.

At this time Mr. W. R. Patterson, now of Chicago, was working along independent lines, and made a form of hydraulic press for drawing on the lead cable sheath, which is still in use as the standard method of manufacture, although many changes of detail in the conductors have been introduced, with the result of improving telephonic transmission to over five times that of the first cables using twisted pairs.

Cables are applied for miscellaneous other uses outside of conduits wherever the lines need protection against water, moisture or accidental violence. They are used for submarine lines at bridge draws and river crossings, where they appear to be the especial targets for fouling anchors and snarling propellers. The cables across the Mississippi at New Orleans become overlaid by the soft viscous mud of the river, which is so tenacious that it is impossible to pull them up again.

They are applied in tunnel work and in mining, and have even been led to a stranded steamship. At Honolulu there are special facilities for laying temporary cables to vessels anchored in the harbor, furnishing them with telephone service when in port. In all United States seaports, vessels moored to wharves can promptly obtain temporary telephone service, for which wires already are placed upon the wharves ready to be extended to telephones to be installed in the cabin.

The modern office buildings are provided with channels in the walls for telephone wires, and also parallel grooves under the floors in multiples of three feet from the front side of rooms, so that wires can be run from the wire entrance of the building up through the floors to positions convenient to reach desk telephones, for as the telephone connections are made in less time than any other service, such as passenger elevators in buildings, or attention by salespeople in stores, so it takes too much time for the average business man to step to the telephone many times a day, and the electrical mountain must go to the commercial Mahomet, by placing the telephone on his desk.

These laterals and distributing pipes conveying the cables branching from the main system are sources of trouble in cold climates, for water penetrates them, usually by backing up from a flooded manhole, and by freezing in the space between the pipe and the cables, crush them until the insulation becomes impaired.

The former course required the expensive method of using a portable steam boiler, generally a city fire engine, to blow in steam from twelve to thirty-six hours to melt the ice, and then cut out the cable, which must be replaced by another one.

The Chicago Telephone Company equipped a wagon with step-down transformers and conductors which could be attached to the electric light wires and furnish a current of seven hundred amperes at a low voltage.

THE RATE OF TELEPHONE DEVELOPMENT.

It has been the endeavor to submit, as far as facilities for illustration provide, some of the obstacles presented by natural conditions to the construction and maintenance of telephone lines, in order to secure an appreciation of the engineering skill which has overcome these obstacles to the extension of the telephone service which now knits together in one system over 26,000 different settlements throughout this country.

The establishment of this vast plant from small beginnings was attended for some years with a rate of increase which may appear slow in the light of later events, until the full development of long line service unified the whole in one connecting system, the value of whose service is far in excess of what could have been derived from isolated plants in separated towns.

These wider facilities endowed the telephone service with a higher value whose worth was appreciated, and the installation of telephones became stimulated to such a degree as to tax the resources of the various departments engaged on the work.

During the last five years the number of telephones in the system has increased at a greater rate than ever before. This increase has been building upon itself like compound interest at the usurious rate of twenty-nine per cent a year, and compounding each year at this rate would double the number in two and three-fourths years, or the number of telephones has actually increased over three and one-half times during the last five years.

Each of these instruments as soon as installed comes into full service for connection with other instruments, and thus reciprocally each new telephone adds to the availability and, therefore, the value of those with which it may be in communication.

During this last five years these additions of twenty-nine per cent a year have required corresponding amounts for the enormous increase in construction of a new plant, which is entirely separate from the maintenance and repairs of the existing property.

Truly the fabric of mental fleece,
Resembles a weaver's masterpiece,
Where a thousand threads one treadle throws,
Where fly the shuttles hither and thither,
Unseen the threads are knit together,
And an infinite combination grows.
GOETHE—FAUST, Sc. IV.

Automatic Fire-Alarm.

According to the *Manufacturer,* Philadelphia, an automatic fire-alarm has been invented by a Danish scientist which will act only when a sudden wave of heat is generated in an enclosed space. The alarm is not influenced by an evenly created high temperature as would be caused by intense summer heat, or the artificial heat used for warming buildings.

The alarm consists of a small glass tube bent into a U-shape, with closed ends. It is half filled with mercury, and the upper part contains a highly volatile liquid. One end of the tube is enclosed in a non-heat-conductor, so that a sudden rise in temperature affects only the exposed end. A wire is fused into both ends of the glass, and reaches the mercury when the latter is in its normal position, and a continuous electric current then passes through. If a sudden wave of heat strikes the instrument it affects only the unprotected part of the tube, and the volatile liquid expands, forcing the mercury into the covered end and severing the electrical connection, thus setting in motion an alarm.

Fourth Annual Chicago Automobile Show.

The fourth annual Chicago (Ill.) automobile show will be held from February 4 to February 11, 1905. It is expected that a large number of manufacturers of automobiles, both foreign and domestic, will exhibit at this show. The manager is Mr. S. A. Miles, New Southern Hotel, Chicago, Ill.

The Manufacture of Air-Insulated Cables.

By Emile Guarini.

FOR some years past the study of electric insulating means has acquired considerable extension, and not a day passes, so to speak, without some new composition being introduced which, the inventor fondly hopes, will be destined to quickly drive all other insulating mediums from the market. On the other hand, patient and exhaustive experiments are being carried out in almost all electrical works with a view to determining the extent to which confidence may be placed in such insulating means, the losses resulting from their use, the maximum potential they will bear under continuous or alternating current, the most suitable form that may eventually be given to such a medium, and how it will act both inside and out on fine and rainy days, etc. The great interest attached to this subject is explained by its great economic importance in connection with the transmission of high-tension currents. In this case a few hundred volts, more or less, could easily have a vital influence upon the capacity and efficiency of the whole line, because, in many instances, if the tension could be slightly increased without giving rise to losses of current, then—should the consumption increase, for example—it would not be necessary to lay down a new conductor (which is often very expensive) in order to cope with the augmented demands for current. Insulating means have, consequently, extreme importance in connection with modern electrotechnics. Unfortunately, the more they are improved the dearer they become. There are certainly some insulations which cost but little; there is even one which can be had gratuitously—namely, air in a dry state. The only regrettable point is that it will not stand high tensions, but it is highly suitable in the case of low voltages. Hence, for some time past attempts have been made to utilize it. The process of insulating these cables, as effected for some time past in Messrs. Siemens & Halske's cable works, at Nonnendamm, where air is used as an insulating medium in connection with the manufacture of telephone cables, is interesting.

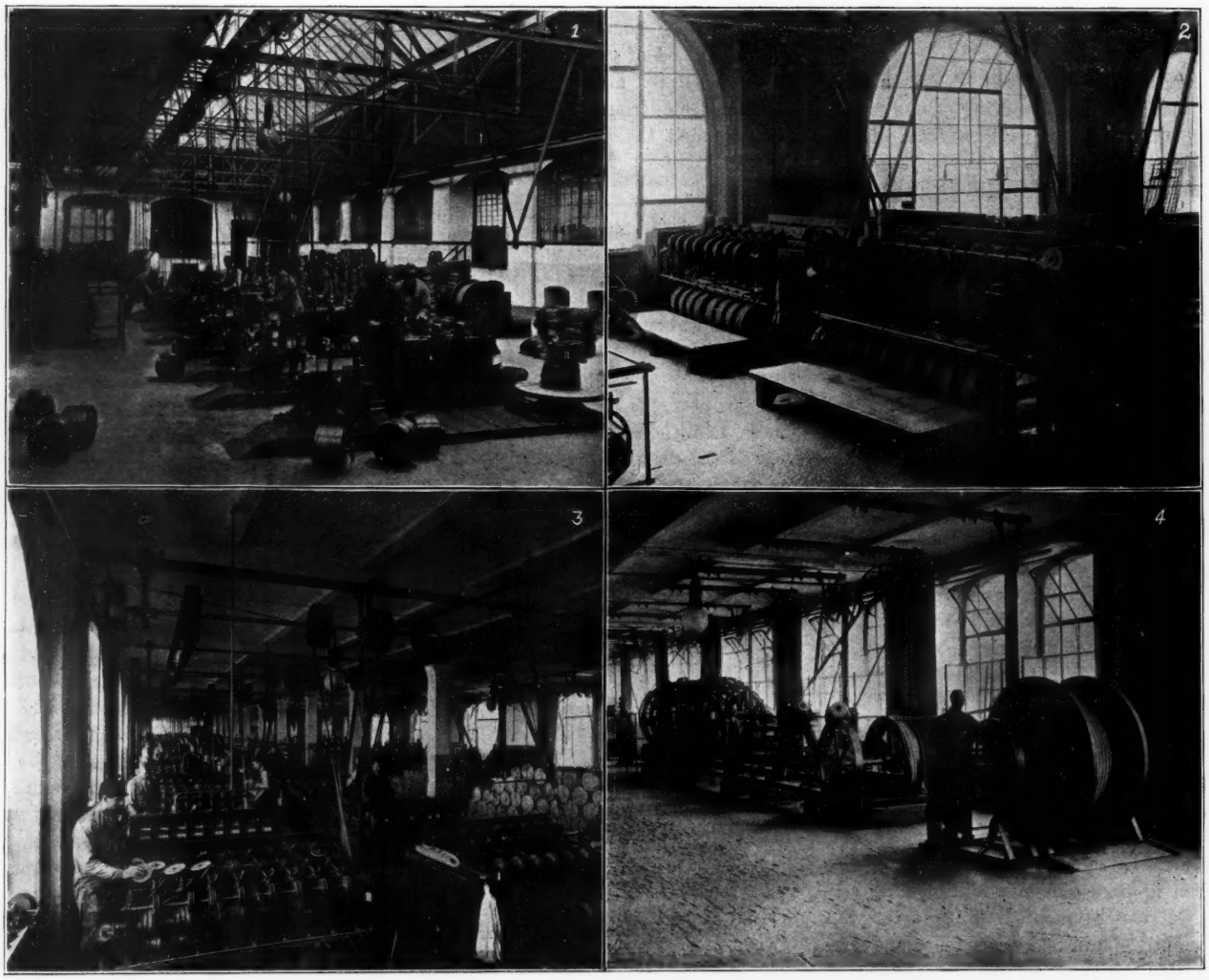


FIG. 1.—ROLLING UP COPPER CORE WIRES. FIGS. 2 AND 3.—WIRE-COVERING MACHINES. FIG. 4.—TWISTING OR CABLING MACHINES.

After having been wound on reels by machines placed in front of the warehouse, the copper wires intended to form the core of the cables pass from the copper warehouse, situated on the ground floor of the northern wing of the central

building of the works, to the cable-making room, where there are machines for making cables arranged parallel to the central building. The drums of the cable-making machines turn out the cores of the cables ready covered with wire, and send them to the firing rooms, and then to the lead pressing room, where the wires receive their leaden jackets. From this room they pass to the testing vats, arranged parallel to the pressroom. Here the cables, and more especially their leaden jackets, are tested under water as to their water-tight, or more accurately speaking their insulating, qualities. This room is situated on the ground floor of the central building. On leaving the testing vats the cables pass direct to the armoring machines, where they receive their protective covering against all mechanical deterioration. This covering is formed of a network of iron wires or strips. The room where this operation is carried out is situated on the ground floor of the southern wing of the works. Fig. 1 shows the method of rolling up the copper wires used to form the cores of the telephone cables; these come in the form of bundles from the wire-drawing machines, and are wound upon the reels, by the aid of which they are placed upon the machines to be subsequently used. Figs. 2 and 3 show the covering machines, by means of which the wires are covered with a series of paper layers. A special guide-carrier device leaves a space between the copper conductor and the layer of paper. This space is filled with air, and forms one of the insulating layers of cables. The wires, after having been covered with paper, are automatically wound upon forms in such a way that each wire forms a core. Two of these cores are then made into a cable by means of a special machine, one of them serving as the outward and the other as the return conductor. The commencement of a cable, thus formed, is now again wound upon a reel. The bobbins or reels, thus formed, are then put into twisting or cabling machines, by the aid of which the coils are transformed into cables (Fig. 4).

Usually the various layers of these twisted cores are concentrically arranged. In the case of cables of the more solid type they are again surrounded with a fine layer of material with a view to imparting greater cohesion to the cable.

The cable is then wound upon a drum, from which it passes to a drying arrangement where it is dried for a considerable time in vacua. The drying is effected partly by means of heating coils, and partly by means of the exhaust from the drying drum. Fig. 5 shows this drying device opened; Fig. 6 shows the drying device closed, and also a condenser.

When the drying is completed the cable is given a smooth seamless coating of lead. Fig. 7 shows a lead press, of the

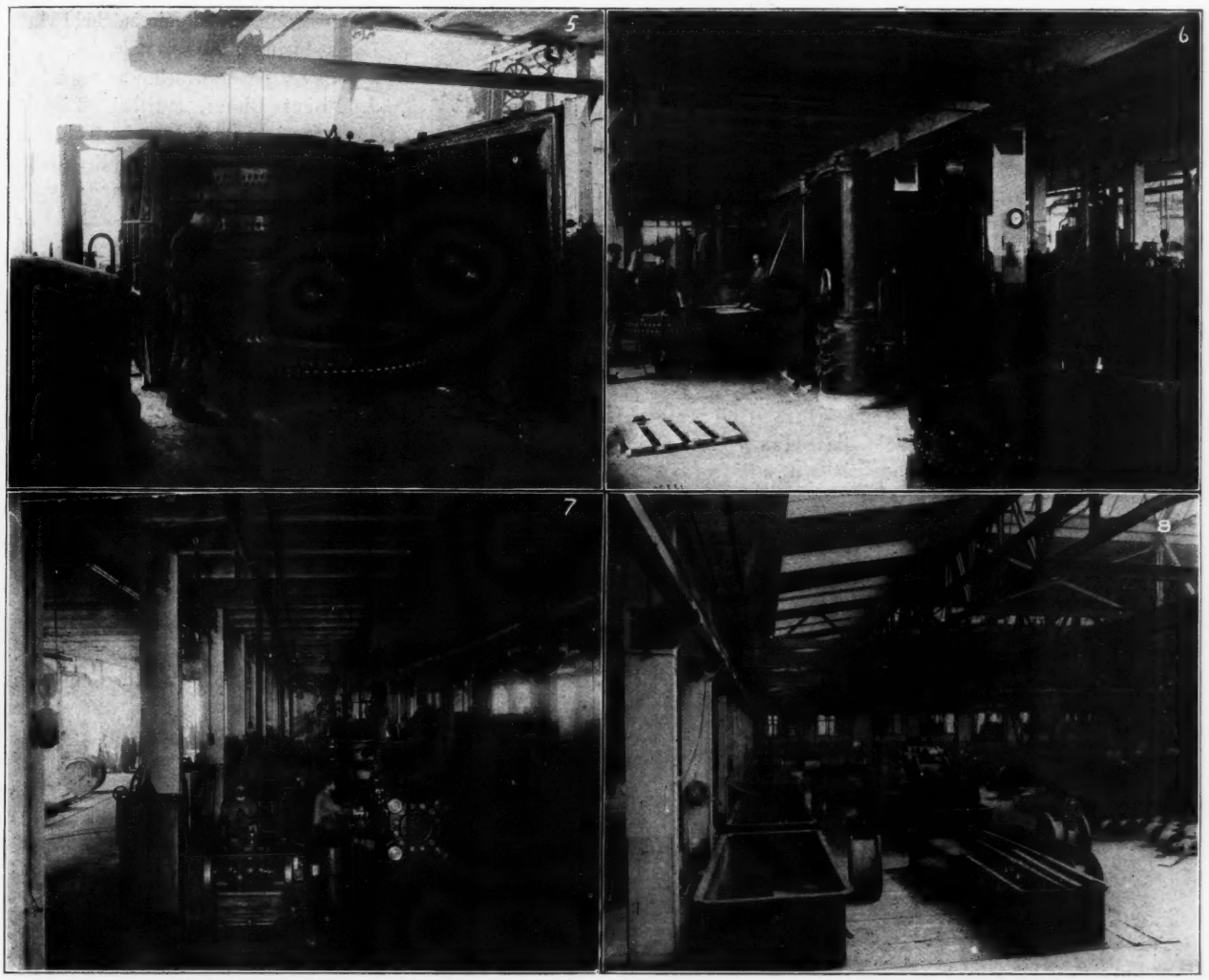


FIG. 5.—DRYING DRUMS, OPENED. FIG. 6.—DRYING DRUMS AND CONDENSER. FIG. 7.—HOT TYPE LEAD PRESS. FIG. 8.—VIEW OF TESTING-TANKS.

hot type, as used for this purpose. The cable passes through it from right to left.

Fig. 8 gives a view of the testing tanks. In order to test the impermeability of the covering of lead the cable is immersed in water, so that only the ends are left free; these are to be connected up to the measuring wires. If the meter shows a defect in the lead the cable is removed, dried again, and then given a fresh coating of lead, whereupon the same test is again applied. If the results obtained are favorable the cable is then armored by winding it round with a layer of iron or steel wire.

In order to protect the leaden jacket from all chemical influences, there is always placed beneath this layer of wire a layer of insulating paper, and then another elastic layer of jute fibre. Upon this the armoring is then adjusted (Figs. 9 and 10).

If the cable is intended for subterranean use the armoring is well asphalted and protected by means of fireproof jute. In order that the coating of asphalt may harden quickly, and to prevent the layers of cable upon the drum from sticking together during transport, the cable is finally passed through a vat filled with lime water. Fig. 11 shows the whole of such an armoring machine. This completes the processing of the air-insulated cable.

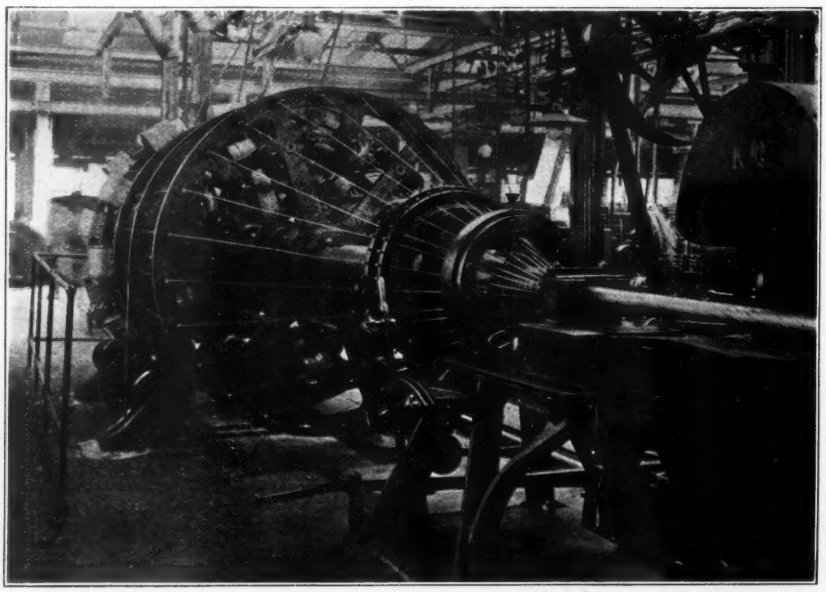


FIG. 9.—FRONT VIEW OF ARMORING MACHINE.

FIG. 10.—REAR VIEW OF ARMORING MACHINE.

The Therapeutic Importance of Electric Light.

In the transactions of the American Congress on Tuberculosis, held in St. Louis during the past year, is published a valuable paper which was read by Dr. J. Mount Bleyer, entitled "Light—Its Therapeutic Importance in Tuberculosis as Founded upon Scientific Researches."

The first part of this paper dwells at some length upon the physical theory of light, and then passes to a discussion of the effect of light upon organic life, and the influence of the solar rays upon chemical combination and precipitation. The author discusses the question of the value of light in treating disease, and shows how solarization by the sun or electric arc should be effected, and the physiological and physical influence which these rays have.

A review is given of the experimental researches with the electric light upon greenhouse plants, Siemens's conclusion being quoted, that the electric light can be profitably employed in horticulture and that in the future "the horticulturist will have a means of making himself practically independent of solar light for producing a high quality of fruit at all seasons of the year." It is shown that growth can be hastened by the addition of electric light to daylight, and that injury does not necessarily follow continuous light throughout the twenty-four hours. The electric light often deepens the green of leaves, the tints of flowers, and sometimes intensifies flavors and aids to produce good seeds. Siemens believed that the addition of the electric light enables plants to bear a higher temperature in the greenhouse than they could otherwise.

Deherain found that, when using the electric arc, it was necessary to screen the plants with a clear glass globe, or otherwise serious injury followed. When this is done the greater part of the injurious rays emitted by the arc is modified, and the arc contains enough rays to maintain full growth of the plants for two and one-half months. The light, however, is too weak to enable sprouting seeds to

prosper, or to bring adult plants to maturity.

Dr. Bleyer then passes to the use of arc chromolumes, an arrangement for producing violet rays of light in an electric arc, as an adjunct to the treatment of tuberculosis. His specially constructed electric arc lamps for producing these rays have undergone some modification since they were first brought out in 1896. It was found that the concentration of light is important, as this gives greater penetrating power. The lamp has also been much simplified. These rays have a great penetrating power, and when they are passed through the chest wall they enable negative plates to be prepared in less than fifteen minutes.

Dr. Bleyer has used these colored rays in treating tuberculosis of the lungs with most successful issue in sixty cases. He believes that electric arc solarization can be considered one of the greatest tonics and bacteria destroyers. Of the sixty cases treated, he reports forty cured, and in twenty the disease was arrested to such an extent as the pathological changes present when they came under treatment would admit. He believes that his experience shows that such light rays play an important rôle in the treatment of this disease.

The lamps are now made in different types, suitable for different classes of supply. The alternating-current lamps for high tension and low tension are constructed to operate automatically or to be regulated by hand. In order to get a steady, pure light spot, these lamps are provided with a concave mirror which enables the light to be thrown out in parallel rays. Any part of the pulmonary apex or any other portion of the anatomy can be treated by means of these. For the low-tension, direct-current lamp the focal lines are created by a Mangin mirror, somewhat on the principle of the search-light. The lamps are made in different sizes, using from 10 to 100 amperes, the smallest lamp having a focal length of three and one-half inches, and the largest a length of seventeen and one-quarter inches. The lamps are provided with a screen and hood carrying a shutter in front for cutting down the size of the light spot, and they are provided further with a chromolume consisting of a sheet of blue glass cut in strips, which cuts out all the heat rays of the beam of light. The paper concludes with a number of details concerning the construction and use of these lamps.

FIG. 11.—GENERAL VIEW OF ARMORING MACHINES.

A High-Frequency Alternator.

A paper on "A High-Frequency Alternator" was read by Mr. W. Duddell before a meeting of the London Physical Society, held on December 9. The author described and showed in action a high-frequency alternator which he had constructed in 1900 for some experiments on the resistance of the electric arc, and with which frequencies up to 120,000 periods per second had been obtained. The alternator consists of an inductor, built up out of ferrotype plate, having V-shaped notches cut in its edge so as to have flat-topped teeth. Surrounding the inductor is a laminated ring having two inwardly projecting poles, the clearance between these and the teeth of the inductor, which formed the air-gap, being less than 0.1 millimetre. The ring is wound so that a direct current flowing round the winding tends to produce lines of force from one pole to the other through the inductor. The number of lines of force varies from a maximum when the teeth of the inductor are opposite the poles, to a minimum when the poles are in front of the spaces. This variation in the total number of lines of force produces alternating electromotive forces in any winding either on the pole-pieces or on the ring itself; the movement of the inductor through the distance between two consecutive teeth producing one complete period. One winding on the ring could serve to carry both the direct field current, which magnetizes the ring, and the alternating current produced. In practice, owing to the great importance of any self-induction in the alternating-current circuit, it was found advisable at high frequencies to use separate windings for the two currents. At the highest frequencies the best results were obtained with coils having a few turns of wire fixed right on the tips of the poles. The alternator is driven by means of a figure-of-8 belt drive from two phosphor-bronze discs. Each of these discs is belted to a double-grooved pulley fixed on the shaft of a direct-current driving motor. With this method of drive the inductor was run for several months at speeds between 30,000 and 40,000 revolutions per minute, and the spindle of the inductor alone could be easily run at 60,000 revolutions per minute. Using inductors having 30, 60, 90 and 204 teeth, the author obtains small alternating currents having frequencies from a few hundred periods per second up to 120,000 periods per second. An illustration will perhaps convey some idea of how high a frequency of 120,000 periods per second really is. In plotting curves for ordinary frequencies of 50 to 100 periods per second, a scale often adopted is ten inches for 100 periods. If it were attempted to plot a curve up to 120,000 periods per second to this scale, the curve paper would require to be 120,000 inches, or nearly one-fifth of a mile long. Many difficulties were encountered with the centrifugal forces on the driving belt, and the author finally obtained the best results with a spliced cotton cord. Working drawings of the alternator, characteristic curves, and its wave-form are given in the paper. During the construction of the alternator bicycle wheels were used to drive it, and curves are given showing the very large power taken to drive these wheels, owing to air friction.

City Street Lighting at Sewickley, Pa., a Successful Six-Glower Nernst Lamp System.

The Sewickley (Pa.) Electric Company may truly be considered the pioneer in the use of the Nernst lamps for street lighting; in fact, the installation, which is the first of its kind in this country, was made before the organization of the Nernst Lamp Company.

The town of Sewickley, with a population of 4,000, is located on the north bank of the Ohio, twelve miles west of Pittsburg. In its general beauty, modern conveniences and the high standard of the community, it probably ranks first among Pittsburg's suburban towns.

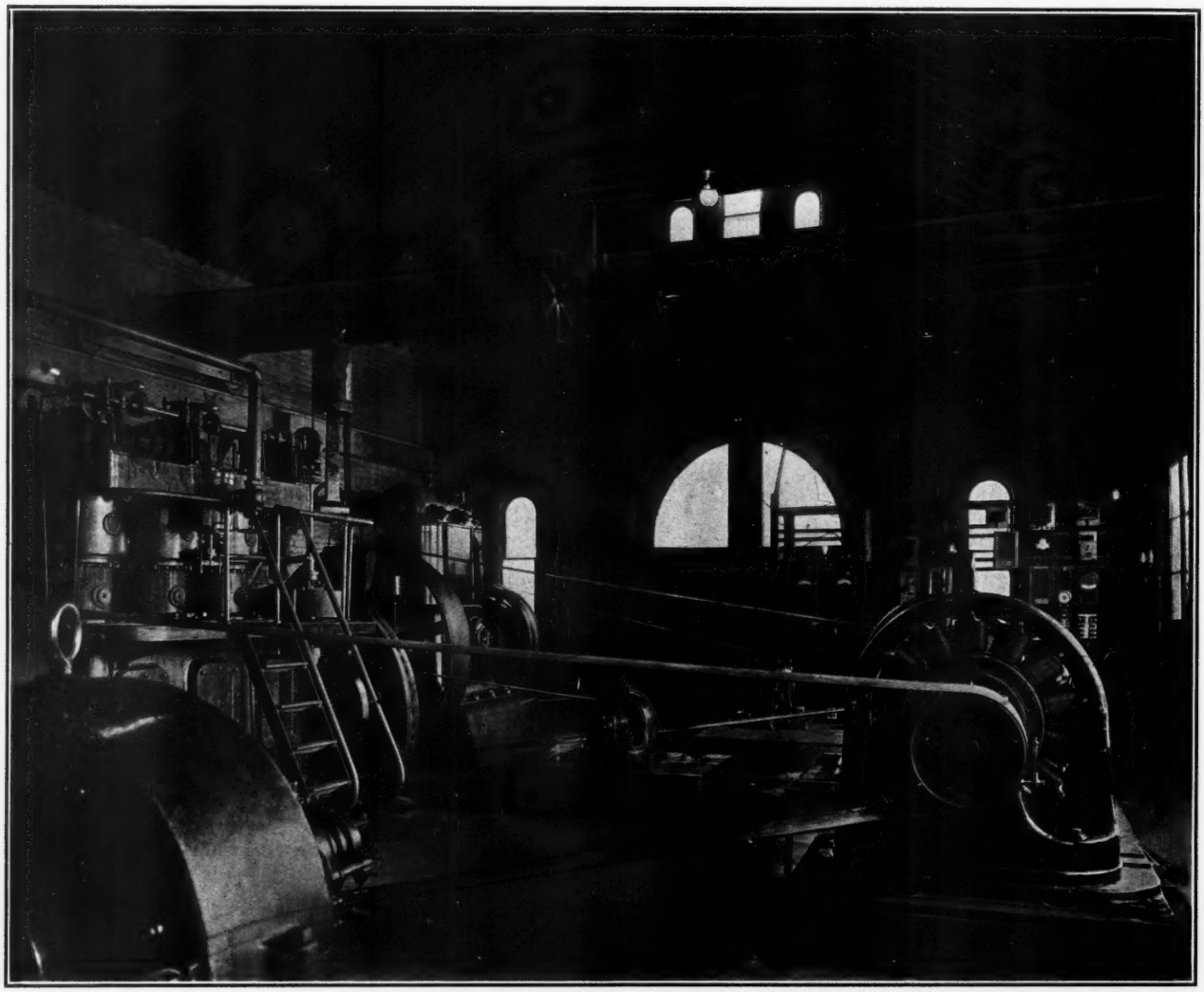


Fig. 1.—Interior View of Power Plant, Sewickley, Pa.

At present the installation consists of ninety six-glower lamps of the outdoor type, equipped with clear eight-inch globes. Fig. 1 shows an interior view of the power plant which is located at the extreme south edge of the town near the river. It not only supplies current for the street, business and residential lighting, but also furnishes power to operate the city waterworks. The electrical equipment consists of three Westinghouse alternators of 60, 90 and 90-kilowatt capacities, belted to three Westinghouse three-cylinder gas engines of 85, 175 and 150-horse-power capacities, respectively, thus giving three separate units controlled from a common switchboard of up-to-date pattern. Each alternator is separately excited from its own exciter. The switchboard connections are such that the load may be shifted from one machine to another, and all three machines excited from any two exciters should the third fail. The interior of the plant is effectively lighted with four six-glower lamps at twenty-foot elevation.

The sixty-kilowatt unit, carrying through the day a small commercial load and at night the street-lighting system, generates single-phase current of 16,000 alternations, at a pressure of 1,100 volts, which is transmitted over a pair of No. 4 lines suitably protected by lightning arresters at different points, to a number of transformers, varying in capacity from one to seven and one-half kilowatts. These are distributed over the system, each supplying current to one or more lamps at 220 volts from their secondaries. Fig. 2 is a diagram of the system showing the location of the lamps and transformers.

As may be seen from the accompanying street views, Fig. 3, standard arc lamp practice is followed in the suspension of the lamps, the latter being supported well out near the centre of the street at an elevation of from twenty-two to twenty-five feet, the lamps being lowered to the ground for trimming by means of the pole pulley as shown. Owing to the smaller size and less weight of the Nernst as compared with arc lamps, the mast-arms used are much heavier in their construction than is necessary, but as a part of the original arc system these were draughted into service to save further ex-

pense. While the elevation of the lamps is less than that recommended for six-glower lamps, a greater height was impracticable owing to the dense foliage lining the streets during the summer season.

and care of the lamps are left to the company's lineman, who devotes one-third of his time to this work; the remainder being spent on his regular duties as lineman. It is estimated that the total cost of maintenance, including interest and

small boys of stone-throwing propensities. Reports indicate that the system as a whole gives good satisfaction, and is considered superior to the former system, due to the light being more natural and pleasant in quality; an absence of "flicker"

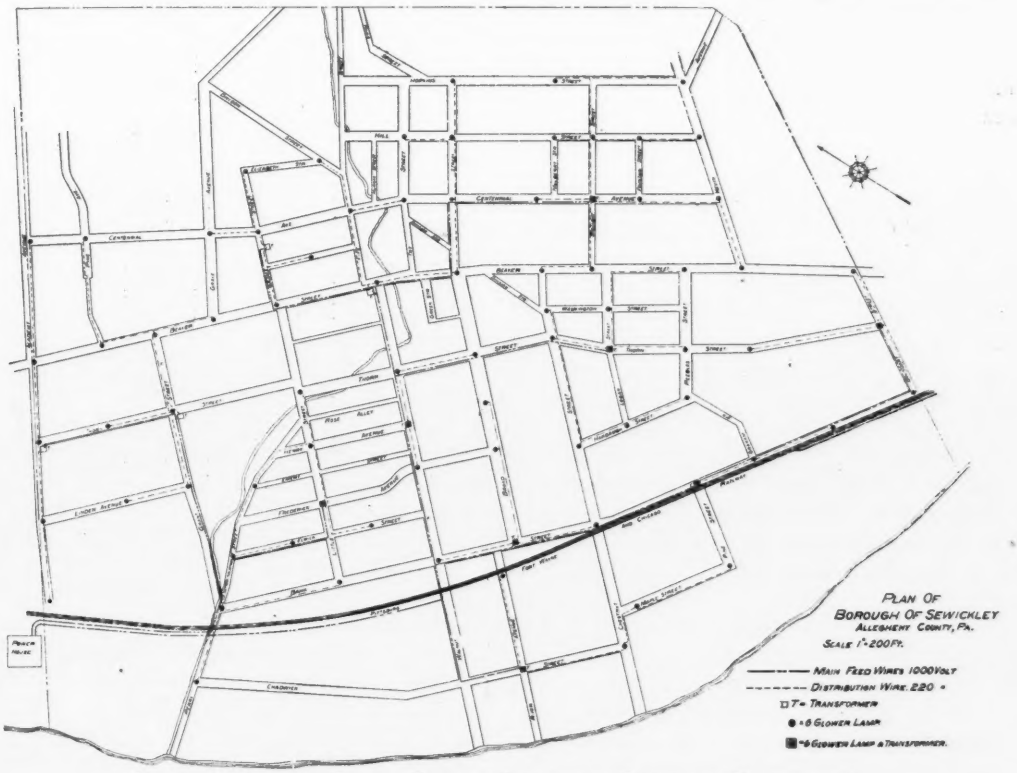


FIG. 2.—DIAGRAM OF SYSTEM, SHOWING LOCATION OF LAMPS AND TRANSFORMERS.

The distance between lamps ranges from 150 feet in the business districts to 800 feet in the outlying streets.

Since the installation was made about

depreciation, is one-half cent per kilowatt-hour. In this connection, it may be mentioned that there is an estimated saving of seventy-five per cent in the yearly cost

or wandering tendency of the light and elimination of shadows; the number of "outages" are comparatively few as some light is still obtained from the lamp, even

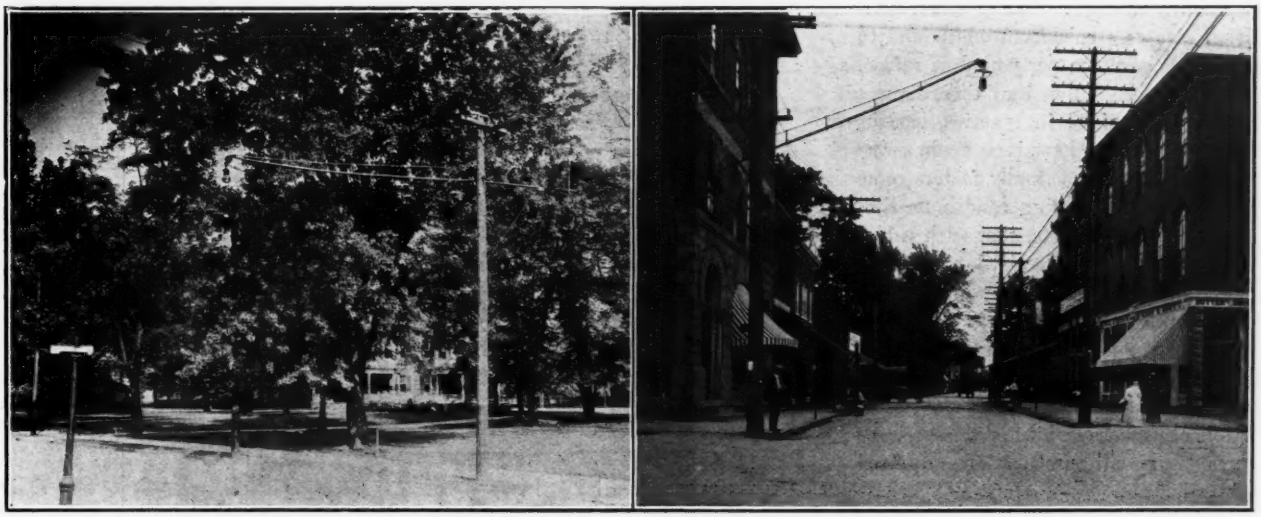


FIG. 3.—STREET VIEWS IN SEWICKLEY, PA., SHOWING METHOD OF HANGING NERNST LAMPS.

five years ago, the performance of the lamps has entirely fulfilled the claims made by the manufacturer, both as to lighting effects obtained and the maintenance cost. The complete maintenance

for glassware incurred under the preceding arc system. There are two reasons for this: one, that the Nernst glassware is cheaper; the other, that the lamp being smaller, is not an easy target for

though two or three of the glowers are broken, and in the discharge of his duties the trimmer is not exposed to dangerously high voltages as in the series arc system.

THE COMBINATION OF DUST DESTRUCTORS AND ELECTRICITY WORKS ECONOMICALLY CONSIDERED—II.[1]

BY W. P. ADAMS.

I will now proceed to lay before you the results of investigations I have recently had occasion to make while preparing a large scheme for combined works. While gathering information as to the actual quantities of electricity generated from refuse over a period of one year from the larger London and provincial installations, it became apparent that the average figures recorded in table B did not represent the ultimate value of the refuse. To take an instance, the electricity works at Fulham are alternating, and the day load is small even in winter. In summer the load is still smaller, and the peak load of short duration. Where some 120 tons of refuse are burned per diem, any substantial increase in the rate of burning during the peak is, as I have indicated, inadmissible; at Fulham there is no increase. It was therefore plain that if an all-the-year-round figure of some twenty-six units per ton was obtained, this value must at times be largely exceeded, for it was certainly not reached in summer and on the small day load. I therefore set to work to plot out curves so as to gather some indication of the ultimate value to be anticipated. One curve led to another, and I have now to show you quite a representative collection. I shall only have time to deal with the five London combined undertakings and one or two provincial.

Specially arranged tests of steam generation give as a rule from one pound to two pounds of steam per pound of refuse, and on the assumption that these figures could be maintained in practice, various ingenious estimates have been made showing fine values; but so many factors come into play under working conditions that are non-existent in tests, that such calculations may well be received with some scepticism. Under ordinary working conditions from twenty to forty units per ton are often obtained, and occasionally claims are made that better values are being secured and from fifty to sixty units per ton are mentioned with diffidence, as figures that will probably be received doubtfully.

Shoreditch—The Shoreditch vestry adopted the first combined destructor and electricity works to supply more light, more power to the inhabitants. Their

[1] Abstract of a paper read before the Institution of Electrical Engineers, London, England, December 15, 1904. The first portion of the paper was printed in the ELECTRICAL REVIEW, January 7.

TABLE B—ELECTRICITY OBTAINED FROM REFUSE.

	Name of town.	Year.	Tons of refuse burned.	Other purposes besides generating electricity for which steam is supplied.	Is steam or electricity data from refuse measured separately?	Coal burned in electricity works.	Coal used for gen'g steam for other purposes.	Quality of coal. Name.	Quality of coal. Cost per ton in bunkers.	Lbs. coal per unit generated independently of destructor. Winter.	Lbs. coal per unit generated independently of destructor. Summer.	Lbs. coal per unit generated independently of destructor. Av'g for year.	Average steam used per unit generated. Coal.	Average steam used per unit generated. Refuse.	Units generated exclusively from refuse. Total.	Units generated exclusively from refuse. Units used in fan motor.	Units generated exclusively from refuse. Net total.	Estm'd ultimate value if all heat utilized in gen'g. Tons.	Estm'd ultimate value if all heat utilized in gen'g. Units generated.	Units per ton of refuse burned. During year, net.	Units per ton of refuse burned. Jan. '04, engrs' estimate.	Units per ton of refuse burned. All refuse utilized. (Est'd.)
London	Shoreditch	1902-3	25,729	Baths and laundry Library heating Deep-well pump	No.	Tons. 6,376	Tons. 676	Welsh smokeless.	21/8	....	....	9	Lbs. ..	Lbs. ..	1,420,000	633,938	100,000	533,938	26,000	1,000,000	21	31	38
	"	1898-9	29,301	Clinker hoist	.....	1,344	.....	.....	19/6	....	....	8	..	..	379,000	849,140	105,000	744,140	42,000	.....	28.5	..	..
	Stepney	1902-3	41,250	Clinker hoist Disinfector	Yes.	2,941	None.	Welsh smokeless.	20/11	5.3-6	6-8	7.13	50	60*	780,379†	1,108,027	.....	1,168,027	.....	1,080,000	28.3	40	40
	Fulham	1902-3	30,300	Brick-making plant Clinker-wkng. plant	No.	1,920	.....	Derbyshire.	13/5	8	12	9.4	50-60	....	461,185	791,300	.....	791,300	36,000	1,870,000	36.2	45	52
	Hackney	1902-3	34,006	None	Sometime.	1,265	None.	Scotch.	13/6-14/8	4.5	6.7	5	27-35	....	563,684	1,360,399	124,223	1,236,176	88,000	2,436,000	37	45	64
	Bermondsey	1902-3	13,806	Baths and washhouses	No.	400	400	Welsh steam. Hard steam.	21/3 10/3	(Estd | mtd.)	9.4	50	....	Nil.	436,157	25,600	410,557	14,000	1,300,000	29.8	..	86.5
	Woolwich	1902-3	6,325	Disinfector and brick-making plant	.....	.....	.....	.....	7/-	7	11.8	11.4	....	....	274,560	196,000	.....	196,000	6,500	260,000	30	40	70‡
	Shipley	1902-3	7,105	None	No.	1,402	.....	Smudge.	7/-	....	....	....	....	....	167,000	.....	.....	.....	6,500	260,000	..	40	40
	Beckenham	1902-3	7,000	None	No.	1,377	.....	Welsh.	24/9	....	....	....	....	....	90,000	21,000	.....	.....	7,500	127,500	12.8	..	17
		1901-2	7,020			.....	.....	.....	.....	....	....	....	....	....	55,494	.....	.....	.....	.....	.....	29.6	..	..
	Partick	1902-3	13,500	None	Sometime.	225	.....	Scotch bituminous.	8/-	....	....	9.1	....	....	98,263	.....	.....	.....	13,500	600,000	29.6	..	37
	Nelson	1902-3	6,658	Disinfector and mortar [mill	No.	1,040	.....	Burgy slack.	8/8	....	....	23	105	....	295,000§	.....	.....	.....	6,700	268,000	40	..	40
	Mexborough	1903	5,496	None	No.	75	.....	Slack.	8/-	10	....	12	80	....	140,000	.....	.....	.....	5,500	182,000	25.5	..	33
	Gloucester	1902-3	7,800	None	No.	1,200	None.	Slack.	10/-	5-6	10-12	15	....	....	180,000	149,591‖	Est. 30,000	119,582	8,000	450,000	15.3	..	56
	Grays	1902**	2,386	None	No.	348	.....	.....	.....	8-10	9-14	9.5	....	....	82,360	35,606	.....	85,606	2,500	75,000	15.0	..	30
	"	1902-3	2,383	None	No.	325	.....	Coal.	17/6	....	....	9.0	....	....	88,500	50,100	.....	.....	.....	.....	21.0	..	..
	St. Helens	1901-2	10,804	3 mortar mills and steam winch	Yes.	604	.....	Coke breeze.	6/6	....	....	....	....	....	1,078,926	401,818	64,000	337,818	.....	.....	31	..	..
	Wimbledon	1902-3	9,000	Sewage pumping and hospital heating	No.	.....	5	.....	21/6	....	....	....	....	....	.....	None.	.....	.....	9,000	300,000	....	..	33
	Accrington	1902-3	11,945	None	No.	3 6	.....	Local steam.	10/6	5	....	6.5	....	....	109,642	126,000	.....	128,000	12,000	250,000	10.6	..	21
	Bangor	1902-3	2,505	None	No.	700	None.	Coke.	18/3	....	....	17.2	....	....	91,487	43,513	6,000	37,513	2,500	62,00)	15	20	21

* 15% for fans and clinker hoist. † Including 44,000 from 140 tons burned at destructor. ‡ Winter only. § Including 7,800 units generated in destructor turbine. ‖ Assuming ⅓ refuse burned usefully.
¶ Coke breeze taken = half value of coal = 30 tons. ** January-December.

wisdom has often been called in question. Besides the awkward arrangement of the accounts, another matter which gave rise to no little controversy was the impression gained, how I know not, by some vestrymen and others, that the works would be able to supply all the requirements of Shoreditch without the use of coal—a very

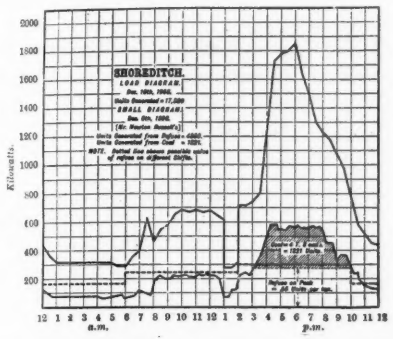


Fig. 2.—Load Diagram, Shoreditch, December 16, 1903.

evident absurdity. I hope it is now generally recognized that only in the case of new works starting on a small load, can a combined works be expected to run without coal, and that the second year of running is almost certain to bring a larger load than the destructor can cope with unaided.

As to the results obtained in the generation of electricity from refuse-raised steam, I have little to add to Mr. Russell's figures

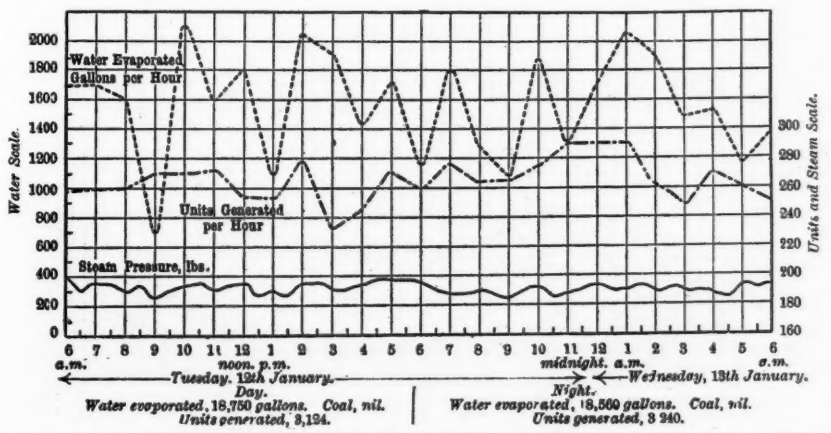


Fig. 3.—Chart Showing Twenty-four Hours' Run of Stepney Destructor, Water Evaporated, Steam and Units Generated. Boilers 1, 2, 3, 4, 5. Furnaces 1, 2, 3, 4, 5, 6, 7, 8, 9, 10. Nine-Inch Steam Main.

of 1899 given to the Institution of Civil Engineers, for under the conditions of working it has not been possible to separate between refuse and coal-generated units. I have one curve, however, that is of interest; Fig. 2 shows the output for December 16, 1903, and is a typical winter day load. Below is plotted Mr. Russell's historical curve of a day's test in 1899; it will be observed that the maximum value of the refuse was fifty-five units per ton, and that during the test the full value of the refuse was not obtained owing to the smallness of the load for the greater part of the day. The dotted line shows the rate of burning now in vogue throughout a winter day, assuming a value of fifty-five units per ton. It will be seen that the load has enormously outgrown the capacity of the refuse, and that therefore its full value should now be obtained. The summer load is also considerably beyond the capacity of the refuse. At the time of Mr. Russell's test all steam was being used for generating electricity, while this is not the case now; in fact, a large and unknown quantity is supplied to the baths and washhouses, heating apparatus in the library, and to a deep-well pump. The whole of the exhaust steam is supplied to the baths gratis, and live steam, which is supplied *ad libitum*, is credited at £248 per annum. Steam for library heating is credited at £15 per annum; and that supplied to the deep-well pump at the baths at one shilling per hour. The whole credit for these purposes amounted for the year ending March 31, 1903, to £302. When it is remembered that the Shoreditch baths are among the largest in London, and that the average coal consumption at the baths at Islington, Camberwell, St. Mary's, Westminster, and St. George, Hanover square, amounts to £700 per annum, it will be seen how inadequate £248 per annum is for Shoreditch.

I have endeavored to arrive at some idea of the true value of the electricity generated in the year from refuse. I do not think, in the light of Mr. Russell's figures for the test year, I should be justified in taking the average coal consumption per coal-generated unit at more than nine pounds—eight was the figure in the test year. Allowing £700 as the value of steam given to the baths, and accepting £15 for library heating and £39 for pumping as fair allowances, some 6,376 less 676 tons of coal will give 1,420,000 units generated, leaving a balance of 633,958 (out of a total for the year of 2,053,958) as generated from refuse, or twenty-one units per ton net—*i. e.*, after deducting units supplied to fan motors: this result was exceeded in the test year by some 7.5 units per ton

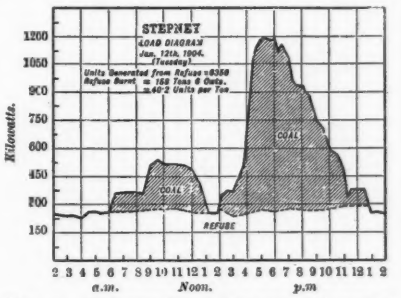


Fig. 4.—Stepney Load Diagram, January 12, 1904.

Two shillings per ton is allowed by the scavenging department for destroying the refuse; adding this to other receipts and deducting the total cost of destruction, a balance of £3,755 remains, and this was debited to the electricity works as the coal value of the refuse. At nine pounds of coal per unit generated the coal cost is 1.04 pence; £3,755 represents 1.42 pence per refuse generated unit—a considerable overcharge.

If 1.04 pence be correct, the total charge would be £2,750, which is equivalent to 25.6 pence per ton of refuse burned; on this basis the scavenging department should allow Mr. Russell two shillings and fourpence halfpenny per ton instead of two shillings. Assuming also that the baths should pay £700 per annum instead of £258, and adding £201 for the disposal of trade refuse, the revenue without credit from the scavenging department would be £3,705, or 34 6 pence per ton of refuse burned; should the library heating and deep-well pump credits be inadequate, this figure should be increased.

Stepney—Stepney does not present the same difficulties as Shoreditch, as the whole of the steam available outside the destructor is supplied to the electricity works. The destructor at Stepney is independent of the electricity works and is under the management of the surveyor, Mr. Jameson. The buildings are on the same site, and the steam main between them is about 200 feet in length. The destructor furnaces are of the same type and general arrangement as at Shoreditch —twelve Manlove Alliott cells and six Babcock boilers. The blast is from steam-

driven fans and there are no economizers, the boiler feed is therefore cold; besides the fan engines and a steam-driven clinker hoist there is no other machinery at the destructor. The generators at the electricity works are direct current, with high-speed, vertical engines, non-condensing; the exhaust steam is partially utilized by feed heaters, and separate steam mains are provided for the destructor steam; generally one generating set is run throughout the day (twenty-four hours)

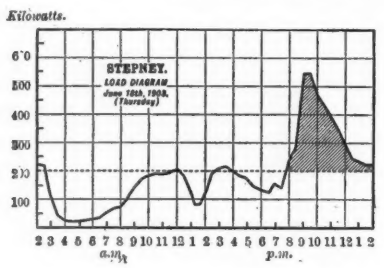


FIG. 5.—STEPNEY LOAD DIAGRAM, JUNE 18, 1903.

on destructor steam alone. A small battery only is in use.

The whole of the steam available from the refuse is not utilized at present, owing to the system of running on one generator. During hours of light load this takes the whole output of the works, and as the load varies the steam generation is varied to suit; when the load is light the surplus heat from the cells is by-passed to the chimney. It will be seen that in course of time this waste should cease, as the generator will always be running at full load; even then some waste may occur, as often the available heat at the destructor is considerably in excess of the capacity of the one generator.

On January 12 and 13, 1904, Mr. Jameson took a set of readings at the destructor and set them out in the form of a curve (Fig. 3), which I am privileged to reproduce. The upper line gives water evaporation per hour, the middle line kilowatts, and the lower steam pressure. Seeing that for several hours during the day the heat from the furnaces had to be by-passed to prevent blowing off, the regularity of the steam pressure is very creditable, the extreme variations being from 185 pounds to 200 pounds. The variations in the supply of feed water are very considerable, and would appear to confirm my opinion that with larger load and a more elastic method of utilizing the steam higher results would be obtained electrically. The results, however, are fairly satisfactory in view of the manner of working and bearing in mind that economizers are not used, that the feed is cold, and that the engines are run non-condensing. The output for the twenty-four hours gives 40.2 units generated per ton, the water evaporated 1.05 pounds per pound at a feed temperature of about fifty degrees Fahrenheit, and a water consumption of 58.7 pounds of water per unit generated. This figure of water consumption includes boiler feed-pumps, fan engines, clinker hoist, and also condensation in the 200 feet of steam main. The water consumption in the electricity works averaged about forty-three pounds per unit generated, including steam to boiler feed-pumps, in the same week—the various losses therefore represent twenty-seven per cent of the total steam generated; assuming that the fan-blast could be run on ten per cent and the clinker hoist five per cent, the remaining twelve per cent represents condensation losses. Mr. Tapper states that the steam is often very wet. The water evaporated by the destructor during the year gave an average figure of 72.5 pounds per unit generated.

To illustrate the relation between the refuse value and electricity works load I have prepared a diagram for January 12 (Fig. 4); the uniform value of the refuse throughout the day is noticeable, and it will be seen that only during the small hours of the morning and the dinner hour can the refuse steam be counted upon to carry the station output. It would appear from this diagram that the ultimate value of the refuse had been realized, but with a different system of running I think we may fairly conclude from Mr. Jameson's figures that a better result may be anticipated; in summer also there are several big gaps in the load, as the curve for June 18 (Fig. 5) will indicate. The solid line is the station output, and the dotted line the approximate value of the refuse under the present arrangements. The quantity of refuse destroyed and also its quality in summer and winter are unusually uniform, and Mr. Jameson considers that its average value all the year round may be taken at 1.2 pounds per pound from and at 212 degrees Fahrenheit. The load curve for the year (Fig. 6) is remarkably like the day curve for its uniformity; the small difference between the summer and the winter values is readily accounted for by the gaps in the summer load referred to. It would appear that the present value of 28.5 units per ton would readily rise to forty, the ultimate value estimated by the engineers, and if improved methods are adopted this might easily reach fifty.

It is a convenience to the electricity works when the whole load of the station is being carried by the destructor to be able to rely upon the supply of steam, and when variations in the load or quality of the refuse results in a shortage of steam, coal is burned in the destructor boilers; in the year under review 290 tons were so burned, and probably with better economy than if steam had been kept up in coal-fired boilers. The destructor costs come out second best in the London combined stations, and it is of interest to observe that the costs at the old destructor on the same site came to about three shillings and sixpence, or about one shilling per ton more. The present credit by the electricity works to the destructor is 0.5 penny per unit generated. During the year 1902-3 the charge was first 0.3 penny, and then 0.5 penny, the average working out at 0.403 penny; seeing that the cost of coal per unit generated during the same period was 0.8 penny, the credit was hardly adequate, as the committee has recognized by fixing the price at 0.5 penny. The capital charges on the destructor installation, including boilers, pumps, steam pipes, etc., amount roughly to 0.2 penny per unit, so the benefit of the destructor steam is divided

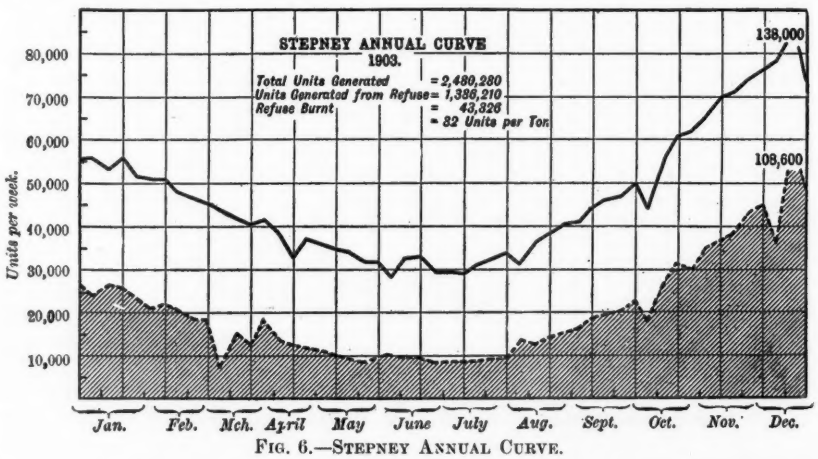


FIG. 6.—STEPNEY ANNUAL CURVE.

equally between the destructor and the electricity works.

As the two works are, to all intents and purposes, independent undertakings, there are no savings in capital cost; on the contrary, assuming that one boiler would have been required in any case for the destructor and two of the remaining five have been saved to the electricity works, three extra boilers have been put down; there is also some extra cost in the steam mains between the works and in the pumps and water-softening apparatus. The old destructor chimney stack, though a source of saving at the first, is not so now, as a second stack has been built for the electricity works.

Fulham—These works were started in December, 1900, and the first supply of steam from the destructor boilers was given in February, 1901. The electricity works plant is two-phase alternating, the engines are horizontal by Musgraves, and, so far as possible, are run condensing. In addition to three 300-kilowatt generators there are three 100-kilowatt direct-current exciters, used largely for lighting the works and driving motors on the works. There are five twenty-horse-power, electrically driven, centrifugal pumps, one deep-well, twenty-horse-power electric pump, four ten-horse-power motors for driving mechanical stokers and coal conveyer, two five-horse-power motors for driving economizer scrapers, and there has recently been added a thirty-horse-power Bellis engine operating a fan at the base of the chimney stack for assisting the draught; this runs continuously, sometimes non-condensing. The destructor consists of twelve Horsfall cells in two groups of six, arranged back to back in threes. Between the two groups there are six Babcock boilers. Mechanical stokers are provided, and much care has been taken to render the fronts of the boilers air-tight when under steam from destructor gases. The main flue is of considerable length. Blast is provided to the destructor cells by steam jets of the usual Horsfall type, and on test the steam consumption was 17.8 per cent of the total steam generated. Economizers are provided in the main flue. At the outset the six destructor boilers were the only boilers installed; three marine-type dry-back have been added. In addition to the electric generators, a supply of steam is given to a steam disinfector some forty yards away, also to a clinker-crushing and brick-making plant. The clinker crusher is driven by an eight-brake-horse-power, simple, vertical engine. This engine is run fifty-four hours per week, and is supplied through eighty feet of one and one-quarter-inch steam pipe not lagged; it probably does not take less than fifty pounds of steam per brake-horse-power-hour. The brick-making plant takes an unknown quantity of steam; the disinfector is generally in use some hours every day, and, although not liberal, £150 per annum is a fair charge for steam supplied. The Bellis fan engine is supplied through 100 feet of branch piping, and probably takes thirty pounds of steam per brake-horse-power on the average; this plant was started in October, and has been running continuously since November, 1903.

I have gone into some detail with regard to the plant installed, as this has an important bearing upon the results. The steam-raising test when the plant was newly installed gave 1.15 pounds of steam per pound of refuse. The load was absorbed electrically, and an average of sixty units per ton was obtained throughout a day's run.

The water consumption is not often measured, a large part being taken from a deep well in the works, but a test was taken in October, 1903—when the destructor was not running—from 2 P. M. on Saturday to 9 A. M. on Monday, and the average water consumption was fifty-nine pounds per unit generated. The steam disinfector, the brick-making plant and the clinker-crushing engine were shut down during this test, but the Bellis fan engine was in use.

In the case of Fulham my investigations began with a curve for the year 1902-3 (Fig. 7). The average units per ton given me by Mr. Fuller over the year ending March, 1903, amounting to 25.5, aroused my curiosity as to the relative figures obtained in summer and winter. I judged from the arrangement of the plant and the smallness of the day load in summer that probably 25.5 units would be largely exceeded, and when the curve was set out and the carefully estimated coal value filled in, my suspicions were amply confirmed. I have taken great pains to obtain correct coal values, and although the average works out at nine pounds per unit generated, I am satisfied that this is correct. In the earlier part of the year—from June to September—I have ample evidence to show that twelve pounds of coal were used per unit generated. From September to November the condensing plant was out of use, and the coal consumption has been taken at ten pounds per unit; from November onwards eight pounds is the ascertained figure; and, in view of the water-consumption test in October, 1903, I have taken this value in all the later day-load curves. I wish to draw special attention, while this annual curve is before you, to the increasing value obtained as the output grew. It is also important to observe that the whole of the coal consumed on the works has been plotted, and that steam supplied to the clinker, brick plant and disinfector is not accounted for in the diagram. The Bellis fan engine had not been installed at that period. The large dip in December is caused by the Christmas holidays; the big rise between January 15 and 22 is due to the switching on of 100 extra arcs for the street lighting. This increased public lighting load has doubtless some bearing on the fine results now obtained. In view of the undoubtedly very heavy water consumption when the destructor is working, fifty-three units per ton throughout the week is a very fine record figure.

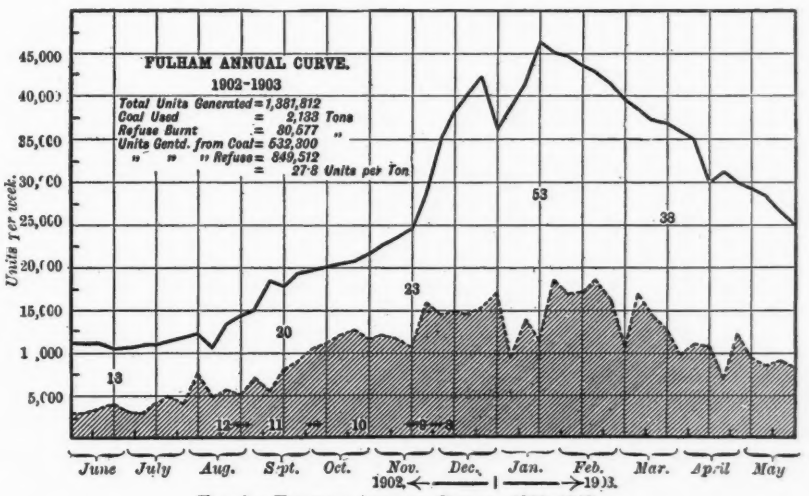


FIG. 7.—FULHAM ANNUAL CURVE, 1902-1903.

(To be concluded.)

Electrical Notes from Europe.

By Our Special Correspondent.

THE annual Paris automobile show, which was held in the latter part of December, has been even a greater success than last year's exhibition. It was held as usual in the vast Palace of the Champs-Elyseés. The number of exhibits was larger than that of last year and all agree that it is the finest display of automobiles which has been as yet seen in Europe. Progress is to be noted along the well-known lines of construction, and there are also a number of novel features to be observed in the way of transmission mechanism from the motor to the rear wheels of the car. The great majority of the automobiles are of the gasoline motor type. Some stationary engines were noted, however, which use heavy petroleum. Steam is employed in two leading systems, the Serpollet and the Chaboche among the light cars and also on the Scotte tractors. The electric systems show a great variety this year and it is evident that the inventors are seeking for new methods. The combined petrol-electric system, in which the gasoline motor drives a dynamo, and the latter charges a battery of accumulators on the car, seems to have gone out of favor this year, and in place of this we have a number of systems of electric transmission from the petrol motor to the rear axle. Some of the electrical firms which entered the field by constructing petrol-electric cars have now gone into the manufacture of petrol cars of the ordinary type. This is the case with the well-known Compagnie L'Industrie Electrique, of Geneva. It is also to be noted that several of the large electrical firms are now commencing to build gasoline cars. The Westinghouse company has an exhibition of the new Westinghouse-Schmid automobiles this year and the Allgemeine company, of Berlin, has a display of the new cars which are now being built by a branch firm, the Neve-Automobil Company. Among the electric automobiles several were noticed in which the system of electric transmission is used. The petrol motor, instead of being connected with the rear wheels by a mechanical transmission device for changing the speed, now uses a dynamo and an electric motor to accomplish the same result. The dynamo is mounted on the shaft of the petrol motor and generally runs at constant speed. The field and armature circuits are run into a controller and from there a circuit passes to a motor placed in the rear of the car. The current which the dynamo delivers is varied by the controller, and the motor on the rear wheels can be run at any desired speed. This gives an easy control of the car. The Krieger company has now abandoned the use of accumulators and brought out a new car which was one of the attractions of the show. It works on the above general principle, but has two small motors in the rear, one against each wheel, and the latter are thus independent. The Cardinet system uses a single motor for operating both rear wheels.

Another type of car which deserves mention is known as "La Magnetic." It uses a mechanical transmission from the petrol motor to the rear wheels, but the mechanical device is operated by means of a series of electromagnetic friction clutches. The speed of the rear shaft is changed by throwing different sets of gears in and out of play by a magnetic clutch mounted on each gear, which allows it to run loose on the shaft or to be coupled rigidly to it. This gives a great ease of movement in the manœuvre of the car. Different companies have tried to adapt the magnetic clutch to automobile mechanism, but this is the first time that the attempt has met with success.

It will soon be necessary to reorganize the system of operating the traction lines in the city of Paris and the suburbs, and the minister of public works recently appointed a special commission to find out what will be the best method for carrying this out. The main causes of the change lie in the fact that the concession of the Compagnie Générale des Omnibus will soon expire and that the opening of the Metropolitan subway has also changed the conditions of traffic considerably. The commission appointed by the minister held its first meeting not long ago and proposed two different solutions for the problem. In the first, all the city omnibus and tramway lines would be turned over to the city of Paris, which would then give a certain number of concessions for operating the lines. The suburban lines would be transferred in like manner to the department of the Seine. In the second case, the city and department would be divided into a certain number of sectors by imaginary lines passing from the centre to the circumference. The traction lines of each sector would be operated separately under a series of concessions granted by the city, while the department of the Seine would give concessions for the suburban lines in the same way. Before taking any definite measures, however, the minister decided to appoint a commission of experts to visit the different cities of Europe and find out what methods are employed.

Three-phase motors are now used in a number of cotton factories in Spain belonging to the Marquis de Larios. It was decided not long ago to run the factories by electric power in place of steam and at present two of the mills have been equipped with electric motors. The current is taken from a plant belonging to the Chorro Distribution Company, which is now operating a large hydraulic station in the gorges of the Chorro at forty miles from the city of Malaga. Current is sent to the city over a 25,000-volt overhead line and the voltage is lowered by substations in the city to 2,500 volts. The two cotton factories which now use the current are located at 2,600 feet from the primary substation. It is expected to equip the whole number of factories with electric motors, representing a total of 5,000 employés, and an annual economy of power of twenty per cent will thus be obtained. Each of the two factories in question has a special substation, and the current is finally lowered to 400 volts for supplying the three-phase motors. These range from three to 150 horse-power, and there are about seventy-five running at present, representing a total of 2,500 horse-power.

Among the recent hydraulic plants in the mountain region of France may be mentioned the Bournillon station which is located on the Bourne, a rapid mountain stream near Grenoble. The stream is fed by a number of springs and a head of 102 metres has been obtained, with a mean flow of 2,500 litres per second or a total of 2,500 horse-power. A canal 1,800 metres long and a penstock 1.20 metres in diameter bring the water to the turbine plant. The latter has been built to receive six turbine-dynamo sets. Three of these have now been placed in the station and the remainder will be installed after the

next increase is made in the plant, as it is proposed to utilize another 300-metre fall. The turbine has been furnished by A. & H. Bouvier, of Grenoble, who carried out all the hydraulic work. The dynamos are built by the Schneider company. A current of 3,800 volts is generated by the machines and this is sent to step-up transformers and raised to 3,500 volts. A long-distance overhead line carries the current through the surrounding region, where it is used in different industries.

The new light and power station which is building at St. Denis, in the suburbs of Paris, will be one of the largest in Europe. The electric outfit is supplied by Brown, Boveri & Company. The station is laid out on the three-phase system. It will contain four steam turbine and alternator sets, using the Brown-Boveri turbine which is now proving so successful in different European plants. These groups are to furnish 5,000 kilowatts each. The speed is 750 revolutions per minute and the voltage 5,000 at twenty-five cycles. Smaller turbine sets will be used for the exciting current. Each of the latter will supply 300 kilowatts at 200 volts, running at 2,700 revolutions per minute. The station will also have two motor-generators of 375 kilowatts each, which will furnish part of the exciting current. A large battery of Tudor cells having 1,300-ampere-hours capacity will be used as a reserve for the exciting current and also for starting up the motors which operate the boiler feed-pumps.

Each of the steam turbines is provided with a steam-operated oil-pump which distributes oil under pressure to all the working parts. The turbines are built to operate at a pressure of twelve atmospheres at the inlet. Superheated steam will be used, at a maximum temperature of 360 degrees centigrade. Under these conditions the turbines show a consumption on test of 6.8 kilogrammes of steam per kilowatt-hour. At present the station building is 200 by 70 feet, but it is laid out so that its length can be increased to 300 feet and over, as it is expected to install a number of 10,000-horse-power units in the future.

A new system of road locomotives has been brought out by the Siemens-Schuckert company. It is now in use very successfully on a line running through the valley of the Veischeide as far as Belstein. Current is taken from a double overhead line by a pole and a form of sliding trolley which is adapted to the purpose. The locomotives are equipped with two Siemens-Schuckert motors of twenty-five kilowatts each, and weigh 6.5 tons. They can carry a load of two tons. The locomotive draws a train of three trailers, each of which can carry a net load of 5.5 tons. The present system is controlled by the Schiemann company, which is specially engaged in operating this form of train. One feature to be noticed is that all the cars are connected to the locomotive or with each other by a coupling device somewhat resembling that which is used on the Renard auto-train in Paris. Part of the motive power is transmitted through the coupling to the wheels of each car so that it becomes self-propelled to a certain extent. This gives it the advantage of passing around curves in the same path with the locomotive, and it does not obstruct the track. On the other hand, the dead weight of the locomotive can be made smaller.

Single-phase current is now used upon a railroad line in Germany. It is said to be the first example of the use of single-phase motors for traction in Europe. The line runs from Mederschonweide to Spindlerfeld. The equipment which has been supplied by the Union Gesellschaft consists of a locomotive-car and a train made up of passenger cars. It makes an average speed of twenty-five miles an hour and consumes thirty watt-hours per ton-kilometre. At present there is but one train running upon the road along with the ordinary trains, but if successful, there is no doubt that other trains will be used. The train makes a daily run of 150 to 500 kilometres. Up to the present it has already covered a distance of 30,000 kilometres. In this connection it may be remarked that it is proposed to use single-phase motors on a part of the local railroad in the north of France between Nivelles and Braine l'Alleud. The length of the road to be operated on the single-phase system is about fourteen miles. The Société Nationàle, which now has control of the lines, wished at first to apply the three-phase system and opened a concourse for different projects. But none of these proved satisfactory and a second series was opened for single-phase systems. The latter are now under consideration.

A somewhat novel form of mercury vapor lamp has been brought out by a Berlin firm. It uses two carbons which form an arc and mercury vapor is supplied to the arc from the lower part of the lamp. To carry this out the two carbons are placed in the top and bottom of a glass tube and are separated in the centre to form the arc. The tube is here enlarged in the form of a globe. In the annular portion around the lower carbon is placed the mercury which is vaporized by the heat and fills the tube. A solenoid at the upper part controls the top carbon, while the lower carbon is fixed. The length of the arc varies in different sizes of the lamp and ranges from thirty to one hundred and fifty millimetres. One advantage of the new lamp is that it starts up quickly. It is said to give a very good quality of light which contains red rays. It consumes but a small amount of energy, or 0.5 watt per candle-power.

An extensive system of tramways in the neighborhood of Leeds is now operated by the Wakefield & District Light Railways Company, which obtained the concession for a number of lines. These have a total length of thirty miles at present, but it is expected to increase the length to seventy-five miles before long. These lines connect the Leeds traction system with the lines at Wakefield and run through Ossett, Oulton and other localities. An arrangement has been made so that the cars can run directly to the centre of Leeds. Current is supplied by a large generating station which has been recently erected at Wakefield. It is equipped with Dick-Kerr machines of 400 kilowatts, run from Howden engines. Distribution is carried out at 6,300 volts and there are two substations which supply 200 volts for the traction lines. The substations are connected with the main station by underground cable. The car trucks are equipped with Dick-Kerr motors. It is expected that there will soon be fifty cars or more running on the lines. It will be noted that the system is controlled by a private company, while the Leeds and the Wakefield systems are each operated by the municipality.

The lighting of the new Munich Theatre has been carried out on the most modern plan. The three-phase current which is received at 5,000 volts is reduced to 250 volts direct current by two rotary sets which work in connection with a large battery of accumulators. The wiring of the theatre is carried out on the three-wire system, using 220 volts between outside wires. A very complete arrangement of light is used for the stage effects and all the circuits are controlled from a large keyboard. The hall is lighted by fourteen arcs which are hung from the ceiling, and by incandescent lamps. There are 3,438 of the latter and forty-two arcs in the whole of the theatre. The scenes are shifted by two five-horse-power motors which are placed on either side of the stage.

C. L. DURAND.

Paris, January 7.

BOOK REVIEWS.

"Maxwell's Theory and Wireless Telegraphy." Part I—Maxwell's Theory and Hertzian Oscillations, by H. Poincaré, translated by Frederick K. Vreeland. Part II—The Principles of Wireless Telegraphy, by Frederick K. Vreeland. New York. McGraw Publishing Company. Cloth. 255 pages. 6 by 8 inches. Illustrated. Supplied by the ELECTRICAL REVIEW at $2.

In a just review of this book, parts i and ii should be considered separately. Each part is complete without the other, and the book as a whole belongs among the important works on this subject. In regard to H. Poincaré's work (part i), it should be stated at the outset that it well exemplifies the traditional clearness of French scientific writers. Maxwell's great generalizations, the very "Principia" of modern electrical science, and Hertz's classical experimental verifications are treated with a simplicity and brilliancy of style that is well preserved in Mr. Vreeland's translation. It may be said that part i successfully declares the great electrical truths of Maxwell's theory in the language of every-day life and that one who reads it with intelligent attention will be prepared to understand the presentation, in part ii, of that wonderful application of the experiments of Hertz which we call "wireless telegraphy." As stated in the preface, no attempt is made in part ii to settle questions of priority of invention, nor to describe the myriad forms of apparatus, but the six chapters proceed to inform the reader, in concise terms, upon the broad underlying principles of the art of wireless telegraphy. The division of the subject into lessons having a natural sequence and the treatment of specific cases (theories, circuits and apparatus) so as to emphasize what is essential, are well calculated to equip the reader to understand other more detailed publications of systems and improvements. The explanations are greatly aided by happy use of fragment diagrams prepared so as to afford instructive comparisons between representative systems as the work proceeds. The value of the work as a means of preparing the reader for a careful study of existing systems is especially shown in the chapter on "Selective Signaling" at the end of the book. The tuning problem itself is clearly stated in modern terms, and the various attempts at its solution are traced in logical order. Perhaps a too rigorous brevity of statement obtains where the claims of rival systems are set forth; and the book is somewhat at fault in assigning credit for work in selective signaling, the important basic patents of Stone being omitted from mention. The advances due to the use of closed oscillating circuits with condensers of large capacity compared to the antennæ, and the probable development and limitations of selective systems, are set forth with the aid of well chosen mechanical analogies and illustrations. A good index adds greatly to the usefulness of the work.

"Electric Furnaces and Their Industrial Applications." J. Wright. New York. Norman W. Henley Publishing Company. Cloth. 288 pages. 6 by 8½ inches. 57 illustrations. Supplied by the ELECTRICAL REVIEW at $3.

This work shows evidence of being very hastily thrown together by collecting much that is good and considerable that is not from scientific and technical periodicals and from patent specifications. The introductory historical chapter was evidently an irksome task, as no attempt is made to credit those early workers who, despite the handicap of primary batteries, laid much of the foundation of discovery on which the present art rests. Even the discoveries of calcium carbide and carborundum and the names of Wilson, Acheson, Heroult and a host of others are not mentioned till later in special chapters, and the reader is left, after the first chapter, with an idea that Siemens suggested the electric furnace and Moissan discovered all the modern products, including the two carbides above mentioned. The author touches the high temperatures attainable and their measurement in an entirely inadequate manner, giving no idea of the difficulties of even the roughest approximations. Temperatures of 2,000 degrees to 3,500 degrees centigrade, based on guesses, are given with the weight of demonstrated fact. The translation from centigrade into Fahrenheit is particularly amusing, the book abounding with such figures as 3,632 degrees Fahrenheit, 2,757 degrees centigrade, etc. The author's classification follows the usual lines. His general remarks repeat the story of the inefficiency of steam as a prime mover, and the marvelous cheapness of water power which only costs " the interest on capital outlay for plant and maintenance." The same might be said for a tide motor or a windmill. The availability of water power in electric furnace industries might well have received much more thorough treatment. Throughout the work the author compresses descriptions of real operative processes into too narrow a space, while he makes room for much matter which has never passed the bounds of patent specification. He is seemingly impressionable for ingenuity of design, without being willing to exercise a critical judgment as to its practical value. The chapter on arc furnaces occupies six pages, and shows four sketches taken from patents, with the usual description of the parts A, B and C, the tap hole E, and the flue F. Not a single arc furnace, from the many successful ones used in various industries, is shown or described in this chapter. The chapter on resistance furnaces and processes occupies nearly thirty pages with five illustrations, and is in some respects the best in the book. It takes up a little of the early historical work, and, in general, gives due credit to pioneers. Calcium carbide occupies about fifty pages, and here again the illustrations fail to show modern practice. Neither the Bradley, Bullier, Heroult nor Rathenau furnaces are illustrated, and only a poorly chosen illustration of the Horry furnace is given. When an industry has assumed the proportions of that of carbide manufacture the reader may rightly expect to receive some idea of how a real furnace looks, its size, arrangement and auxiliary devices, rather than a sectional sketch illustrating the inventive kernel, not the industrial fruit. The section on iron and steel production, including references to other processes, is very well handled, and gives the reader a good idea of the place of electric furnace methods in metallurgy, where quality of product is the chief consideration. The manufacture of phosphorus might well have been included in the foregoing chapter where the analogous arsenic process is described. Glass-making, which has progressed little, if any, beyond the experimental stage, scarcely deserves a separate chapter. The section on electrolytic furnaces is an extremely condensed reference to processes involving the electrolysis of fused salts. In view of their great commercial importance these processes should have received more extended treatment. A short section devoted to miscellaneous processes, including the production of cyanides, silicides, artificial emery, etc., closes the chapters devoted to practice real and proposed. The remaining chapters relate to laboratory research furnaces, including the wire-wound types, to a few details of operating technique, theoretical considerations and measurement. The subjects are merely touched upon, and in some cases could have been placed in the early part of the work with advantage. The book would gain greatly by the introduction of systematic references to original articles and patents, and by more illustrations.

Engineering and Commerce.

Mr. James Swinburne not long since delivered a striking address before the students of the Institution of Electrical Engineers, of Great Britain, an abstract of which was published in the ELECTRICAL REVIEW for December 10, page 975. The following interesting comment on the address appeared in the *Electrician* (London), December 30:

I was engaged in the supervising and directing of a test on an 8,000-horse-power synchronous motor during the small hours of the day, and having a few minutes to spare I took up the *Electrician* of November 18, in which you reprint Mr. James Swinburne's address to the students of the Institution of Electrical Engineers, entitled "Some Difficulties in Getting On." The early hour of the day, the strenuous work which had yet to be accomplished by my assistants and myself after we had been working for almost twenty-four hours continually, all this "unpaid-for" devotion did not harmonize with Mr. Swinburne's advice to the students—to take "a money view of everything." The address began to interest me, and I read it carefully, taking pains to keep it from my assistants for fear that they might take a "money view of the situation" and refuse to stay working in their clothes for another twelve hours needed to finish the tests on this largest of electric motors in the world.

Mr. Swinburne's address is entitled "Some Difficulties in Getting On." If this address were delivered to a heterogeneous class of students, not only of engineering, but of law, and of medicine, and of all other branches of human knowledge that can be studied at our colleges, the address might have been very much to the point. It is undoubtedly true that if you want to get on in the world you had better not study engineering or any other scientific pursuit. If Mr. Swinburne objects to the use of the word "scientific," let me say that knowledge is by no means desirable for getting on, and that I hold strongly that the adage attributed to Bacon, that "knowledge is power," requires emphatic qualification.

"Knowledge is power" in the hands of him who can wield it and put it to any use he pleases, but in the hands of most people knowledge is not power, because it controls them, and it is their master while it should be their servant.

When Mr. Swinburne states that "the business man comes out far away above the engineer. He employs the engineer; the scientific man is his servant," Mr. Swinburne is stating merely a matter of fact for which he is in no way responsible. This is a law of the social cosmos against which no amount of railing will avail. This is not due so much to the fact that young men's education now-a-days consists more or less in the study of "Aztec Metempiries," it is due to the fact that both the average student and the average teacher are very average men. Education is given to the boy of very average intelligence by a teacher of very average intelligence, and hence the quality of the knowledge and of the teaching is very average, too. So that, even if knowledge were power, that knowledge which is taught need not be power at all.

Why is it, then, that the engineer is employed by the business man and not *vice versa*? The reason is obvious to any one, although he will be better able to appreciate it if he has read and digested Mill's "Political Economy." It is a fact that capital is the mother of all labor, and that the engineer who wishes to market his ability needs capital, and plenty of it, to turn his ability to account. Shops in which machinery of any kind can be built are expensive, and weekly pay-rolls want to be met, and for all these things the engineer goes to the capitalist, and on account of these things he is the capitalist's servant and the capitalist is his master. This again, is a fact derived from the laws of nature for which the engineer is in no way responsible. "To him who hath shall be given," and as the capitalist can wait for years without starving, the engineer, whose only capital is his brains, wants to live, and therefore has to make a bargain with the capitalist to accept his services. This law of nature which has made capital the mother of all labor, has placed the engineer where he is to-day. The business man without capital is in no better position than the engineer; on the contrary, his position is less enviable, as good business ability is not so rare as good engineering ability, which statement is proved by the fact which Mr. Swinburne can obtain by a study of the social conditions in the United States, that the business man without capital is paid less than the engineer without capital.

When Mr. Swinburne says that "a man's earnings is a rough test of his value to the world," I fear that Mr. Swinburne is making a statement which he learned in the study of "Aztec Metempiries." Money-making is an art just as engineering or medicine is an art. The aim of a great engineer consists in engineering achievement of a high order. The aim of a great surgeon consists in surgical work of a high order. The aim of the money-maker consists in making money of a high order. The standard of measure of greatness in the three professions is different, and hence it is illogical to apply the standard of money-making to these three professions, as money-making is only an incentive to the first two professions, and the aim of the third profession.

When Mr. Swinburne says, "Our leading consulting engineers do not spend a large portion of their lives plotting curves, counting electrons, or even making anything more than arithmetical calculations," I only have to say that—paraphrasing Mr. Swinburne's remark that "electric installation work is merely a sort of electric plumbing"—consulting engineering is mostly jobbing of electric apparatus. The commercial engineer is likely to be neither a first-class engineer nor a first-class money-maker. He is average all the way through, average in intellect, average in engineering, average in money-making. The money-maker of ability will consider him a tyro in money-making; the engineer of ability will consider him a tyro in engineering.

Again quoting Mr. Swinburne, he says, "the engineer will remain in the middle position as long as he takes the middle view and considers engineering as something superior to money considerations, and as long as he looks down on business and commercial methods." Mr. Swinburne here forgets that as soon as the engineer emerges from the position thus outlined for him, he becomes a business man with an engineer's education. But who is going to do the engineering for him after he has entered into the commercial side of engineering? Somebody has to do the engineering work, and to him Mr. Swinburne's criticism will always apply. I have no patience with that cant which we fortunately do not hear so much of now-a-days as we did some fifteen years ago, disparaging the commercial side of engineering work. It is necessary just as much as the purely engineering work is, and to whichsoever a man is best fitted, he should devote himself. But it is due to just such addresses as Mr. Swinburne's that engineering work of enormous commercial value is not duly appreciated by the business man with whom rests the fixing of the compensation for such work. Even engineering work of a very high order is generally underpaid. I do not mean by engineering work of a very high order merely, for instance, designing ability; I mean by it exceptional ability in designing apparatus which is

commercial, and executive ability to direct the large number of assistants who are always needed in large manufacturing concerns.

The men who get on in the world are never of the common run. It seems to me that the hardships of the successful men who are engaged in professions requiring study and knowledge like engineering, law and medicine, are greater than the struggles of the business man, for the simple reason that the tools of the successful business man consist in capital, which is easily convertible into the commodities of life.

The work of the engineer is very much like that of the soldier. The soldiers in the army are numerous, the officers are few, the generals still fewer. Money is not the aim of the soldier, of the officer, of the general. The officer who fell in the relief of Lucknow would have made more money if he had stayed in Cheapside running a grocery.

There is much good in Mr. Swinburne's address, but much that is apt to misdirect the young man's mind. In positions requiring engineering ability, we need engineers and not commercial men, and if a man feels in him the faculty for making money, let him turn his ability into the channels of money-making, and not into the channels of engineering. He will be more successful in money-making than he will in engineering.

B. A. BEHREND,
Chief Engineer the Bullock Electric Manufacturing Company.
Cincinnati, Ohio, December 12.

Automobile Shows in New York City.

The fifth annual automobile show, given under the auspices of the Automobile Club of America and the National Association of Automobile Manufacturers, made a most successful opening on the evening of January 14. The exhibition space in every quarter of the mammoth amphitheatre and in the auxiliary exhibition halls at Madison Square Garden was crowded to its greatest limit.

More than ever this year has use been made of the incandescent lamp for advertising sign purposes. Myriads of incandescent lamps, used for decorative designs of various forms, help out the general scheme of illumination, and render even the remotest recesses of the garden as bright as daylight. The New York Edison Company is a notable user of incandescent lamps for advertising sign display. A mammoth hoarding, fully fifty feet wide and twelve feet high, announces that the company will supply current in any quantity, either for business or pleasure.

Chief among the exhibitors of electric vehicles is the Vehicle Equipment Company, for which the Ranier Company, New York city, is general sales agent. In the exhibit of the Ranier Company there are shown a number of electric vehicles for heavy draught service. There is a five-ton truck built for F. A. Poth & Sons; a one and one-half ton and a five-ton truck for the Wisconsin Condensed Milk Company; a one-ton truck for the Metropolitan Disinfecting Company, and a five-ton windlass truck. This latter truck has a drawing capacity of five tons, and a windlass capacity of five tons. A truck built for Alexander Revell & Company has a capacity of two tons. There are also a one-ton and a five-ton truck, which have been built for Armour & Company, of Chicago. In addition to the heavy-service vehicles there is an electrical hansom, leather upholstered throughout and fitted with every modern appointment. There is also an electric victoria furnished in maroon. At one end of the Vehicle Equipment Company's exhibit booth is a General Electric 55-110-volt, thirty-ampere charging panel with rheostat. There are mounted upon this panel a Thomson voltmeter and ammeter and a starting and load-switch, a mercury vapor alternating-current rectifier, together with the alternating-current line-switch and the direct-current line-switch and pressure regulator.

The Electric Vehicle Company, Hartford, Ct., makes a fine showing of Columbia electric vehicles.

The Pope Motor Car Company, Indianapolis, Ind., exhibits a number of "Waverly" electrics, as follows: model No. 36, speed road-wagon; model No. 27, stanhope; model No. 26C, "Chelsea"; model No. 30, station wagon.

The Studebaker Automobile Company, South Bend, Ind., in addition to its excellent gasoline automobile exhibit, shows a number of new types of electric vehicles. Among these are included an electric victoria-phaeton, an electric runabout, electric stanhope, a 1,000-pound electric truck and a panel-side delivery wagon.

The Baker Motor Vehicle Company, Cleveland, Ohio, exhibits the Baker "Imperial," weighing 850 pounds, and the Baker stanhope, weighing 975 pounds.

The manufacturers of electrical automobile accessories were very freely represented. The Apple ignition apparatus, made by the Dayton Electrical Manufacturing Company, Dayton, Ohio, was shown in operation, the continuous spark given by this apparatus being commented upon and viewed with great interest by those in attendance on the exhibition.

The exhibit of the Edison Storage Battery Company, of Glen Ridge, N. J., attracted a great deal of attention.

There were prominently displayed at different booths about the main exhibition hall detailed parts of the assembly of the "Exide" battery, manufactured by the Electric Storage Battery Company, Philadelphia, Pa.

Among others exhibiting were the following: White Sewing Machine Company, Cleveland, Ohio; Northern Manufacturing Company, Detroit, Mich.; National Motor Vehicle Company, Indianapolis, Ind.; H. H. Franklin Manufacturing Company, Syracuse, N. Y.; C. F. Splitdorf, New York city; the Veeder Manufacturing Company, Hartford, Ct.; National Carbon Company, Cleveland, Ohio; American Coil Company, West Somerville, Mass.; Dow Portable Electric Company, Braintree, Mass.; the Standard Welding Company, Cleveland, Ohio; the Lunkenheimer Company, Cincinnati, Ohio; Electric Contract Company, New York city; the United Electrical Manufacturing Company, New York city; William Roche, New York city; Brown & Sharpe Manufacturing Company, Providence, R. I.; American Novelty and Manufacturing Company, New York city.

The Importers' Automobile Salon, which is being held in the Herald Square Exhibition Hall, Herald Square, New York city, from January 11 to January 24, is composed mainly of exhibits from foreign manufacturers.

The attendance at both the Madison Square Garden and the Herald Square shows has been far beyond the anticipations of either management, and the demand for horseless carriages has been greater than was expected by even the most enthusiastic.

Independent Telephone Association of Wisconsin.

The annual convention of the Independent Telephone Association of Wisconsin will be held at the Hotel Pfister, Milwaukee, Wis., January 25 and 26, 1905. From present indications the convention will be a most successful one.

Regular Meeting American Institute of Electrical Engineers.

The 193d meeting of the American Institute of Electrical Engineers will be held at the Chapter Room, Carnegie Hall, 154 West Fifty-seventh street, New York city, on Friday, January 27, at 8.15 P. M. The subject selected for this meeting is "Central Stations." The following papers will be presented and discussed:

1. "Acyclic (Homopolar) Dynamos," by J. E. Noeggerath, associate; electrical engineer, General Electric Company, Schenectady, N. Y.

2. "Modern Central Station Design as Exemplified by the New Turbo-Generator Station of the Edison Electric Illuminating Company of Boston," by I. E. Moulthrop, electrical engineer, Edison Illuminating Company, Boston, Mass.

A New System of Electrical Distribution for Electric Railways.

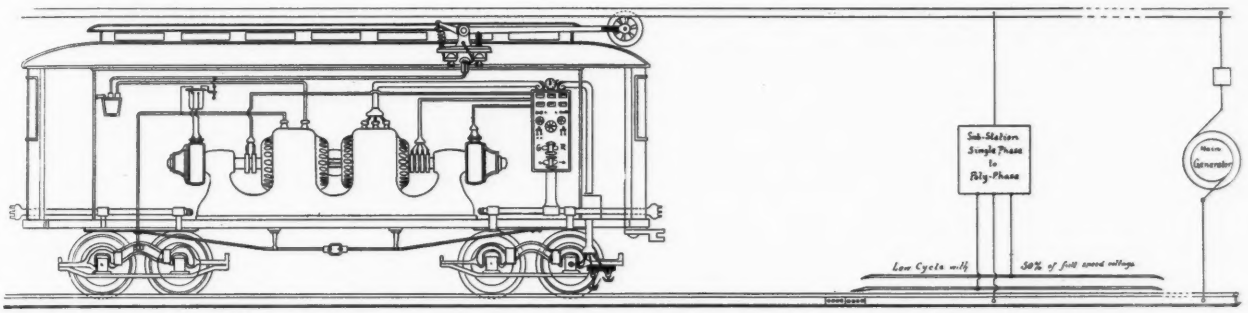
United States patent No. 779,475, for a system of electrical distribution for electric railways, was issued on January 10, 1905, to Mr. Josef Henrik Hallberg. Some of the essential features of this system were brought out last winter at a meeting of the American Institute of Electrical Engineers, when the alternating-current railway motor was the topic for discussion. The system consists primarily of high-voltage, single-phase transmission and low-voltage, polyphase utilization. The patent covers as well the means for converting the single-phase, high-voltage current to polyphase, low-voltage current, and applying the latter to the driving motors. This conversion may be carried out either on a locomotive or in a stationary substation.

Considering first the locomotive, as shown in the illustration, the equipment consists first of a single-phase motor drawing its power from the high-tension line. This motor is mechanically connected to and drives a polyphase generator. The traction motors are polyphase induction motors mounted directly upon the locomotive axles. There is in addition a small direct-current generator used as an exciter for the polyphase generator and for the driving motor, if the latter be a synchronous machine. This exciter may also be used as a starting motor, in which case a set of storage batteries must be included in the equipment; or, if preferred, the battery equipment may be omitted and a small single-phase starting motor used for bringing the main motor up to speed. Thus, under normal operation, the main motor draws power from the high-voltage, single-phase circuit, and this is used to drive the polyphase generator. The driving motors are controlled by varying the excitation of the polyphase generator. This, however, might not give the desired control of the speed of the locomotive, and means are therefore provided which enable the frequency of the polyphase currents to be changed without affecting the speed of the main driving motor. This is accomplished by a special method of winding of the polyphase generator, which enables the number of effective poles to be changed. Thus, assuming the main supply to be at fifty cycles, and the generator to be at full speed, by a commutating field-switch the number of effective generator poles is so varied as to give fifty cycles or twenty-five cycles or any other desirable frequency. In this way the speed of the polyphase traction motors may be changed without the use of inductive or rheostatic regulating apparatus. The latter devices may, however, be used if desirable.

As the system thus outlined contemplates a high-potential transmission system of possibly 20,000 volts, this would not be allowable for urban distribution. It is therefore contemplated to install in cities a converting substation equipped with a single-phase driving motor coupled to a polyphase generator, which will supply to the urban section of the railroad low-voltage, polyphase currents. When a car enters this section of the road the main driving motor and its generator are disconnected from the high-tension line and stopped, and the polyphase induction motors driving the axles are operated by means of the polyphase currents generated in the substation and supplied through suitable conductors. An inductive regulator is provided for controlling the movements of the car on this section of the road. It is contemplated, however, that as the speeds will be lower on the city than on the country section of the road, the frequency supplied to the city section will be lower than that used on the country section.

These, in brief, are the main features of this system. It will be seen that the method of application and control is such that the circuits of polyphase motors are not electrically connected with the high-tension distributing circuit; therefore the former can not affect undesirably the regulation of the generating station, due to the low power-factor at which the axle motors may be operating at times. Moreover, the system of regulation is applicable not only to one set of axle motors, but to a number. In other words, it is adapted to multiple unit control.

The inventor believes that one of the most important features of the system covered by this patent lies in the fact that a locomotive operating in this way requires no commutators on any of the main generators and driving motors. Only one high-voltage conductor along the railway is necessary. This system requires no commutators, brushes, resistances or heavy controlling switches for any main generating or driving machine.



DIAGRAMMATIC ARRANGEMENT OF ELECTRIC LOCOMOTIVE AND DISTRIBUTING SYSTEM.

Some of the broader claims which have been allowed for Mr. Hallberg's system are the following:

A system of electrical distribution for railways, comprising a source of alternating single-phase current, means for converting said current into a continuously symmetrical polyphase current, and polyphase motors actuated by such polyphase current, and adapted to give motion to the motor vehicles upon which they are located.

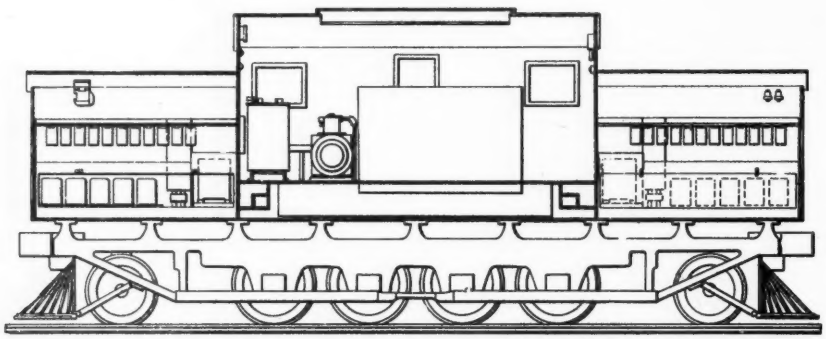
A system of electrical distribution for railways, comprising a source of alternating single-phase current, means for converting said current into a polyphase current of different frequency, and polyphase motors actuated by said polyphase current, and adapted to give motion to the motor vehicles upon which they are located.

A system of electrical distribution for railways, comprising a source of alternating single-phase current, a trackway divided into sections, means for feeding one of these sections direct from the source of alternating single-phase current, and means for feeding the other section by a polyphase current of lower voltage, converted from a single-phase current.

A system of electrical distribution wherein the main source of energy is a single-phase generator, and wherein the sources of energy which effect the movement of the motor vehicles are polyphase generators actuated by, but electrically independent of, the single-phase generators.

Electrical Patents.

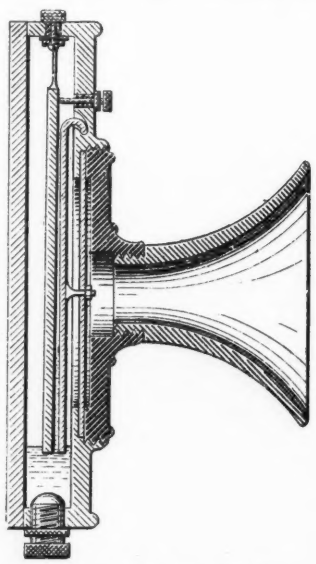
An electric locomotive is the subject matter of a patent (777,693, December 20) recently granted to Edward D. Priest, of Schenectady, N. Y., and assigned by him to the General Electric Company. The



ELECTRIC LOCOMOTIVE.

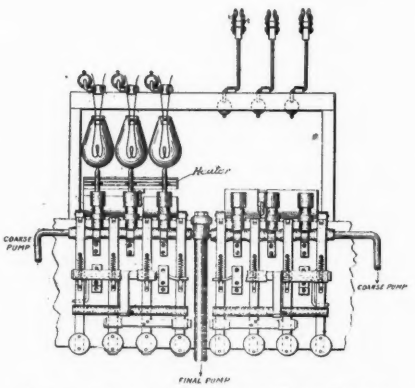
principal object of the present invention is to so organize the cab structure and arrange the controlling apparatus therein that the operator of the locomotive is centrally located while operating the train, has a clear view of the track ahead, and has ready access to all the controlling apparatus and other devices carried by the locomotive without leaving the cab. In this connection it is desirable that the cab be so arranged that when two or more locomotives are coupled together, the operator or operators may pass freely from one locomotive cab to another through covered passageways. A further object is to arrange the sand boxes of the sanding system so as to utilize some of the waste heat generated by current flowing through the rheostats or resistance grids to heat and keep dry the sand in these boxes. The invention consists of an electric locomotive cab which comprises a central compartment or cab proper in combination with covered end passageways leading to said central compartment and smaller compartments on each side of the end passageways for containing certain parts of the controlling apparatus, such as rheostats, contactors, etc. It also consists of the combination in an electrically propelled vehicle of a control system for the motors thereof which includes resistance sections, a compartment in which the resistance sections are located, and a sand box in this compartment so arranged as to be subjected to the heat from the resistance.

Elias E. Ries, New York, N. Y., has obtained a patent (No. 777,808, December 20, 1904) on a telephone transmitter. The invention relates to a new method of transmission of speech electrically, which consists substantially of the utilization of the principle of capillary attraction for controlling the resistance of an electric circuit, instead of using variable pressure, as in the ordinary type. The instrument consists essentially of a reservoir containing a liquid, and two plates which dip into the liquid at their lower edge. One of these plates is attached to the diaphragm situated behind the mouth-piece of the transmitter. The action of sound waves upon the diaphragm causes it to vibrate, and thus causes the two plates to approach and recede from each other, in this way varying the height to which the liquid rises beneath them. The electric circuit is formed between the two plates and the liquid, and the resistance to the current is increased and diminished in proportion to the amount of surface in contact with the liquid between the plates. A wider range of variation in strength of current than is possible in the usual form of microphone is obtained, and the damping of the sound wave by the inertia of the usual carbon or other microphone contacts, which oppose its free motion and demand the exertion of a greater or less pressure of the diaphragm upon them, is overcome. The instrument may be made in various forms. The preferred form has a horizontal reservoir with two bell-shaped plates of slightly different curvature placed horizontally in it. The plates are so shaped that the space between them gradually decreases toward the periphery, thereby producing a large increase in the wetted surface or fluid-covered area for a comparatively smaller movement of the plates toward one another, and thereby causing a great amplitude of variation in the resistance of the circuit when the excursions of the diaphragm are large.



TELEPHONE TRANSMITTER.

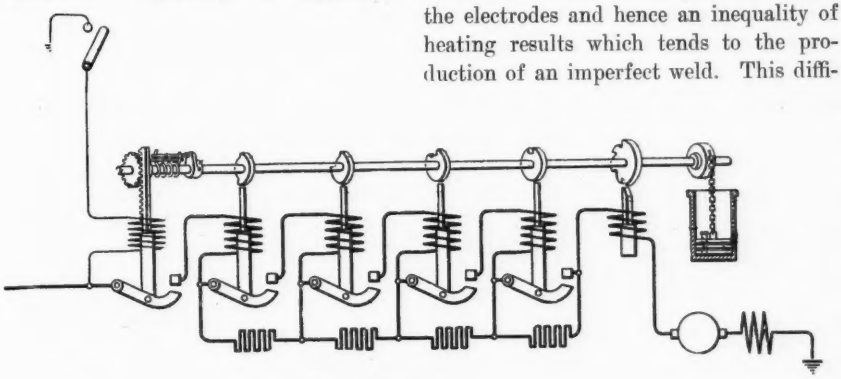
William R. Burrows, of Newark, N. J., has assigned to the General Electric Company, of New York, a patent (778,221, December 27, 1904) recently granted to him on an apparatus for producing high vacua. The invention relates to an improved apparatus for producing high vacua, and is designed to facilitate the operations connected with this procedure to enable a larger output of exhausted vessels per operator to be produced than has been possible heretofore. A plurality of groups of lamps are provided for the management of each operator, either of which may be connected with either of two pumps, a preliminary pump by which the exhaustion is roughly effected and a final pump for carrying the exhaustion to a more perfect state, and cocks are provided by which connection may be quickly made with either group. Means are also provided for expediting the chemical exhaustion. Excellent results are produced by providing the apparatus with means for carrying on the exhaustion simultaneously in two groups of lamps, pump connections being provided by which either group may be instantly connected with the preliminary or final exhaust pump.



APPARATUS FOR PRODUCING HIGH VACUA.

Eugene R. Carichoff, of East Orange,

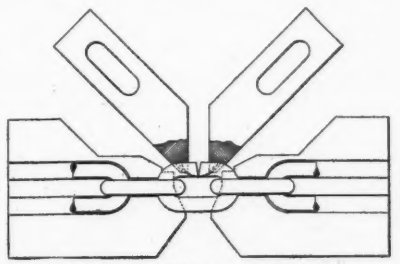
N. J., has assigned to the General Electric Company a patent (777,839, December 20) recently obtained by him on a motor starter. The object of the invention is to simplify the construction and arrangement of a motor starter which will be entirely automatic in its action and will operate to cut out the steps of the starting resistance to a predetermined rate in a positive manner. The device consists of a plurality of separately



Motor Starter.

actuated contacts or switches controlling an electric circuit, preferably controlling the sections of the starting resistance in a motor circuit, the actuating coils of these contacts or switches being successively connected in the controlled circuit each by the operation of the contact next in advance to produce an automatic progression of the contacts together with independently operated means for regulating the progression of said contacts. The invention, also, comprises means for setting the regulating means in operation and a switch for primarily completing the controlled circuit, together with means for controlling the last mentioned switch and regulating means from a distant point.

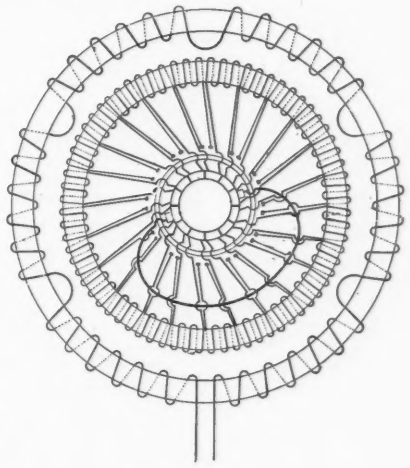
A process of electric welding has been devised and patented (778,269, December 27) by Adolph F. Rietzel, of Lynn, Mass., and assigned to the Thomson Electric Welding Company, Lynn, Mass. The invention relates to improved processes of welding metal by the heating effect of electric currents combined with pressure, and is mainly intended to obviate certain difficulties which arise when the heating current is passed into the parts to be welded at one side by means of electrodes applied thereto in a direction transverse to the line of the welding pressure. A further object of the invention is to obviate certain difficulties which arise in the electric welding of rings, chain-links and other endless forms wherein the weld is made at one side of the ring or link and by a welding pressure applied to the blank in such a way as to tend to develop mechanical stresses or strains in the continuous or unwelded side thereof. When the heating current is passed into the work by tranversely applied electrodes passing heating currents into one side only of the section of metal to be welded and the surfaces to be welded abut throughout or at any but the points farthest from the electrodes, there is a tendency of the work to heat more at the portions nearest the electrodes and hence an inequality of heating results which tends to the production of an imperfect weld. This difficulty is overcome in the present invention by so forming the surfaces where the weld is to be produced that they shall abut initially at their edges or portions farthest removed from the portion where the welding currents are conducted into them, the result of which is that when the current is applied and the pieces are subjected to pressure the heating will begin in those portions which would otherwise, as stated, tend to carry little current and be less heated, after which heating spreads toward the electrodes as the pieces yield and come together. The result is a more uniform heating and a more homogeneous weld. The invention also consists in an improved process of welding metal rings or links by applying pressure to effect the welding of one open side of the link, the



Process of Electric Welding.

other side remaining substantially cold, and in drawing out or reducing the welded side while the pressure is maintained to prevent the link or ring from opening by the strain or stress developed by such pressure and consequent flexure or bending in the cold side. This part of the invention is especially useful in the welding of links, rings, or other endless forms of large cross-section and in which it is necessary to apply considerable force in order to flex or bend the cold portion in order to bring the open ends together and weld them, so that internal stresses or strains of considerable amount are developed which would tend to weaken the welded link if it were employed without first drawing out or reducing the bur or upset of the weld and substantially restoring the welded side of the link to a length which will permit the opposite side to regain its original form.

An electric motor has been patented (778,400, December 27, 1904) by James H. Bryson, of St. Louis, Mo., and the patent assigned to the Wagner Electric Manufacturing Company, St. Louis, Mo. The invention has for its object to secure a motor of large load capacity which at the same time requires but a small starting current. For this purpose a portion of the armature circuits is excluded from active operation at starting, and thus by decreasing the amount of copper



Electric Motor.

in circuit a higher resistance is obtained in the armature, cutting down the starting current. After the motor has started, and preferably after it has attained normal running speed, the armature resistance is reduced by cutting, preferably automatically, additional copper into circuit, thus obtaining a motor of increased load-carrying capacity. At the same time that the additional circuits are cut in the circuit upon which the motor has started is automatically reorganized. The motor consists of a member having a circuit commuted at starting and a second circuit for this member inoperative at starting. Automatic means are employed for simultaneously rendering this second circuit operative and short-circuiting the commutator segments after the motor has started.

Reviews of Current Engineering and Scientific Literature.

The Driving of Cotton Machinery by Electricity.

In discussing the advantages of electrically operated cotton machinery, the following summary is given of the chief claims put forward for this method of driving: the subdivision of the various points of application of the power reduces the liability of breakdown and stoppage; the subdivision of the various floors and sections enables any floor, section or group of machines to be operated independently of any other floor, section or group for overtime or night work; short lengths of shafting ensure alignment, and thus save friction losses; the general lighting is improved by the removal of a large percentage of the belts; the flexibility of the system enables the mill to be put in any position relative to the power operating it, so that it may be located with reference to the production only; extensions or alterations may be made without interfering with production; and depreciation and maintenance charges are very much less in the electrical system than in the mechanical.—*Abstracted from the Indian Electrical, Mechanical and Textile News (Bombay), November.*

The Production and Utilization of Ozone.

In this section of a series of articles on "The Production and Utilization of Ozone," Mr. J. B. C. Kershaw describes several types of ozonizer and refers briefly to their actual use for water purification. A modified form of Berthelot tube ozonizer is now employed by Drs. Bone and Drugman at the Victoria University laboratories, in Manchester. This ozonizer consists of a U-tube formed of two thin-walled glass tubes, one inside the other, their surfaces nearly touching, and sealed together at the upper ends. The outer tube has branches for inlet of air and exit of ozonized product. The conducting medium is a slightly acid solution of copper sulphate, the inner tube being nearly filled with this solution. A stout copper wire passes down each of these tubes. These are connected to the positive and negative poles of the coil or transformer supplying the current. The air passes along the narrow annular space between the inner and outer tubes. The yield of ozone is said to be good. Elworthy's ozonizer consists of a box containing ten ozonizing tubes, each consisting of two concentric glass tubes containing a spiral of aluminum wire. The air passes through the annular space in each of these ozonizing tubes, where it is subjected to the silent discharge. The Vosmaer-Libret ozonizer consists of a transformer, the secondary of which is connected to a condenser in shunt, while a choking coil is interposed in series in one of the branches between one terminal of the transformer secondary and one terminal of the condenser branch. The ozonizing apparatus works without any interposition of dielectrics. Goldstein found that it is the ultra-violet rays of light which are chiefly instrumental in the formation of ozone, and he has designed a quartz tube ozonizer which is said to utilize these ultra-violet rays to the fullest extent. Two platinum electrodes are fixed in the ends of this tube. A vacuum is produced in it, and upon allowing the electric discharge to take place between the two electrodes, the usual colored haze appears. If the tube be placed in an atmosphere of pure hydrogen, cooled below minus 100 degrees, almost the whole of the gas is transformed into ozone by the ultra-violet rays, which pass easily through the quartz glass. This condenses upon the outer walls of the quartz glass tube as a blue liquid. The Rosenberg ozonizer employs two electrodes made up of copper gauze (see ELECTRICAL REVIEW, December 3, 1904). Figures are given for the efficiencies of the different systems, Rosenberg's leading with a yield of 184 grammes of ozone per electrical-horse-power-hour. A plant has been erected at Marseilles, France, for purifying the city water by means of ozone. Current is taken at sixty volts, and transformed to 40,000 volts for use in the ozonizer. The air, before being treated, is dried by passing it over pumice-stone soaked in sulphuric acid. The sterilizing tower is brickwork, twenty feet high and ten feet in diameter, filled with flints. The water flows down through this, meeting the ozonized air as it passes up. At Lille-Emmerin a system of purification by means of ozone was installed to deal with the conditions caused by a severe epidemic of typhoid fever. The voltage used here was 30,000. The normal capacity of the plant was thirty-five cubic metres of water per hour, and it is said that the cost of treatment was 2.4 cents per thousand cubic feet.—*Abstracted from the Electrical Review (London), December* 30.

New 30,000-Volt, Steel-Pole, Long-Span Transmission Line.

A new steel-pole line has been constructed and put into service to form a connecting link between the new steam turbine station of the Edison Electric Company at Los Angeles, Cal., and Englewood, a distance of fourteen miles. At Englewood the lines are tied to the United Gas and Electric system, which was recently absorbed by the Edison Light Company. This line is now in successful operation at 15,000 and 30,000 volts, and is the only line of its kind. The poles are of steel construction, commensurate in size, weight and strength with ordinary wood poles, enabling them to be employed in like conditions of a limited space or right of way. They are formed of three U-bars, from three-eighths to one-quarter of an inch in thickness, arranged 120 degrees apart around the axis of the pole, which has the proper taper. The bars are firmly assembled by means of inside and outside collars at right angles to the axis of the pole, and at two or three-foot intervals along its length. Poles up to sixty feet in length are made of continuous U-bars, while those of a greater length are spliced. This construction is simple, enables all parts to be painted, and reduces the number of parts and joints to a minimum. The strength of the pole at no point is impaired by rivets or bolt holes. These poles were set up complete at the factory. They are set ten per cent of their length in a cylinder of concrete just large enough to enclose them, and a ground wire and plate are installed so that it is not possible to receive a shock from the poles in case the insulation of the line is imperfect. As the line leaves Los Angeles the poles are seventy-five feet in length, spaced from 250 to 275 feet apart, and carry four steel cross-arms, each composed of two U-bars ten feet in length, with a hub at the centre to fit the pole, and firmly bolted together with blocks which contain lead-topped standard thread steel pins. The insulators are standard for 30,000 volts, and are of a new design. On the upper cross-arms are two three-phase circuits for the Englewood line at 30,000 volts, composed of No. 4 seven-strand medium hard-drawn copper cables. As the line leaves Los Angeles it carries in addition three 15,000-volt circuits, which branch off after running a short distance. The

telephone line consists of two three-strand copper cables supported on steel lead-topped brackets four feet below the lower eventual cross-arm. Much difficulty was met in erecting these poles within the city limits, due to the presence of other pole lines along the way. They were raised by means of wagon derricks. Transposition in the line is effected by simply inverting the cross-arm construction. The description is fully illustrated and shows details of the construction of the pole. At points where severe side strains come upon the pole, the latter is stiffened by means of a truss.—*Abstracted from the Journal of Electricity, Power and Gas (San Francisco), January.*

The 5,000-Horse-Power Turbo-Alternator at Frankfort, Germany.

In 1901, to meet the additional demand for power in the central station at Frankfort-on-the-Main, Germany, a 5,000-horse-power Brown-Boveri-Parsons turbo-alternator was installed. The turbine is designed to run at 1,360 revolutions per minute at a steam pressure of thirteen atmospheres and 300 degrees centigrade superheat. The single-phase alternator direct-coupled to the turbine has an output of 2,600 kilowatts at 3,000 volts, and a power-factor of 0.8. E. Guarini gives in this article the results of some tests which were made on this turbine, under ordinary working conditions. These were made by the engineers of the Frankfort Electricity Works.

Steam Pressure.	Temperature of Steam at Turbine Stop Valve. Degrees Centigrade.	Load in Kw.	Vacuum in Percentage.	Steam Consumption. Lbs. per Kw.-Hour.	Steam Consumption. Lbs. per I. H.P.-Hour.
12.63	298	1,945	93.2	15.8	9.9
12.8	295	2,518	91.8	15.6	9.45
10.6	312	2,995	90.0	14.7	9.0

It will be noted that the turbine can give a normal output of 5,000 horse-power, corresponding to a terminal output of 3,600 kilowatts. If the output of the machine on the different tests had been increased to 3,600 kilowatts, and the vacuum raised to ninety-four per cent, the turbine would have been much more economical and would have given the following results:

Steam pressure	10.6
Temperature of steam at turbine stop valve, degrees centigrade	312
Load in kilowatts	3,600
Vacuum in percentage	94
Steam consumption per kilowatt-hour	13.3
Steam consumption per indicated horse-power-hour	8.85

The steam consumption of the turbine with an effective pressure of 12.8 atmospheres, 300 degrees superheat and a load of 2,600 kilowatts was guaranteed not to exceed 15.8 pounds per kilowatt-hour. The steam consumption is better than was guaranteed, and the test shows that the turbine runs at least as economically as the best steam engines of the same output. —*Abstracted from the Electrical Magazine (London), December.*

Cable-Laying.

In this communication Mr. James Perry gives some valuable information regarding his experience during the past fifteen years with underground electric cables. He has tried bare copper laid in conduits, the Fowler Waring cable, lead-covered diatrine laid solid in bitumen in wooden boxing, and india-rubber, lead-covered. When cables were first placed underground it was thought sufficient to protect them from moisture by means of a lead sheath, but fourteen years ago Mr. Perry took the precaution of surrounding the cables of this kind he laid with a good thickness of sand wetted with coal-tar. These cables have never given any trouble. On the other hand, lead-covered cables laid solid in bitumen have given much trouble. This is frequently attributed to improper treatment of the bitumen when laying, it being thought that this material is burned, but the author has come to a different conclusion. A feeder which recently gave a good deal of trouble, and which it became necessary for him to take up, consisted of three separate lead-covered cables laid in one box. Upon examination he found numbers of fine annular cracks or joints in the lead sheathing. The bitumen does not adhere to the lead, and in his opinion there is a continuous joint between the whole surface of the sheath and the surrounding bitumen which is available for damp to distribute itself if it can reach this joint from the outside. This it is enabled to do because sudden shocks or vibrations will crack the bitumen, and if water is present it will penetrate into this crack some distance and will prevent its closing again by the flowing of the bitumen. If there are successive vibrations, the tendency will be for this crack to be opened repeatedly, and will result in the destruction of the cable. Further, there is a tendency of the cable to sink through the bitumen to the bottom, and it is necessary to provide some means for holding it up. On the other hand, there is no tendency for the cable to sink through tarred sand, and the tar adheres to the lead covering. The author has not found any tendency of this tarred sand to crack definitely under vibratory shocks, and as the material is cheap, a large quantity can be used to surround the cable. When he has found it necessary to take up any old cables laid on this method, he has found them firmly fixed in a coherent mass of somewhat flexible tar concrete which does not easily break off from the lead. When the sand is distributed around the cable and then is wetted with the tar, the latter causes it to shrink and press around the cable.—*Abstracted from the Electrician (London), December* 30.

Electricity from the Cold Combustion of Hydrocarbons.

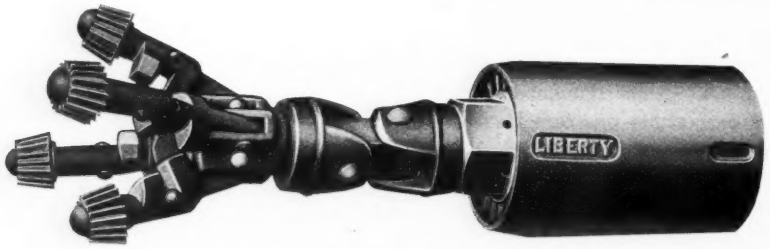
If a piece of discharged lead negative plate be made the cathode, and a plate of carbon the anode in a solution of sulphuric acid, and a current be allowed to flow through this arrangement, it will be found that there will be a back electromotive force of about two volts. Nearly half this electromotive force is produced by the anode becoming coated with bubbles of oxygen. Place this anode in a porous pot and surround it by some substance that will take up the oxygen. Under these conditions it should be possible to charge an accumulator negative at about 1.2 volts. Experiments were made to determine the most suitable material for absorbing this oxygen. The best result was obtained with a solution of glycerine and water, acidulated with sulphuric acid, the back electromotive force in this case being reduced by about half a volt. To obtain electricity from the cold oxidation of hydrocarbons it will be necessary to proceed as follows: the primary cell, having a discharged lead negative in sulphuric acid for one element and a plate of carbon in nitric acid for the other, will be connected to a cell as described above, the cathode of the latter being a discharged lead negative. A cell having spongy lead opposed to carbon in nitric acid gives 1.6 volts. If the discharged lead negative gives only 1.2 volts there will be a difference of 0.4 volt between the primary and the secondary cell, so that, besides regenerating the lead negative, work could be done by the current so long as the electromotive force at the terminals of the regenerating cell exceeded 1.2 volts. The nitric acid used in the primary cell could be reoxidized either by the method patented some years ago by Jablochkoff, or by the method adopted in the manufacture of sulphuric acid. There are a variety of hydrocarbon compounds which might be tried in this way, no expensive apparatus being necessary.—*Abstracted from the English Mechanic and World of Science (London), December* 23.

INDUSTRIAL SECTION.

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS.

The "Liberty" Turbine Cleaner.

The Liberty Manufacturing Company, 6906 Susquehanna street, Pittsburg, Pa., is calling attention to the Liberty turbine cleaner. The accompanying illustration shows the apparatus with freely swinging arm head and universal coupling. The company states that this cleaner will stand an unlimited amount of abuse and remove the heaviest scale in a short time and with little expense.



THE "LIBERTY" TURBINE CLEANER, WITH FREELY SWINGING ARM HEAD AND UNIVERSAL COUPLING.

The apparatus is constructed with either ball bearings or thrust bearings, as desired. The shaft revolves within a hard phosphor-bronze bushing, and the bearings are protected from the sediment in the water by being enclosed within the body of the stationary part. The rotor or wheel, as well as the tool attachments, is connected direct to the shaft, thus securing a rigid and durable construction. The turbine is furnished with any or all of the following attachments, as desired:

1. The freely swinging arm head attached directly to the turbine. This arrangement is adapted for scale up to one-quarter of an inch in thickness.

2. Freely swinging arm head is furnished with a universal coupling connecting it with the turbine. This arrangement is used for heavier scale than the first arrangement. It is also used for cleaning bent-tube boilers, the universal coupling permitting the entire machine to pass around the bends, thoroughly removing the scale from all parts of the tube. The advantage of the universal coupling on heavy scale is that the flexibility of the connection of the tool with the turbine relieves the machine from shock, prolonging the life of the wearing parts and reducing the repairs to a minimum.

3. For very heavy scale a drill is generally used, being attached to the universal coupling. The drill is also frequently used for very hard thin scale. This scale varies so much in different localities that no exact instruction can be given as to which of the attachments is the best in all cases. This is usually determined by experiment in each individual case.

Some of the largest power-houses in the world are using the "Liberty" turbine cleaner for cleaning their boilers. The Manhattan Elevated Railway Company, New York city; the Interborough Rapid Transit Company, New York city, and the Metropolitan Street Railway Company, New York city, have adopted the "Liberty" cleaner as their standard, and use it exclusively in keeping their boilers free from scale. The Seventy-fourth street station of the Manhattan Elevated Railway Company has sixty-four Babcock & Wilcox boilers of 525 horse-power each, six of 650 horse-power each, and sixteen economizers, the boilers and economizers containing 26,084 four-inch tubes. The Fifty-ninth street power-house of the Interborough company contains sixty 650-horse-power Babcock & Wilcox boilers, having a total, including the economizers, of 17,640 four-inch tubes. The Ninety-sixth street power-house of the Metropolitan company has sixty-eight 250-horse-power and fourteen 350-horse-power Babcock & Wilcox boilers. The same company has thirty 525-horse-power Babcock & Wilcox boilers in its Kingsbridge power-house. Together with economizers there are 20,000 tubes.

The "Tuxeda" Bronze Union.

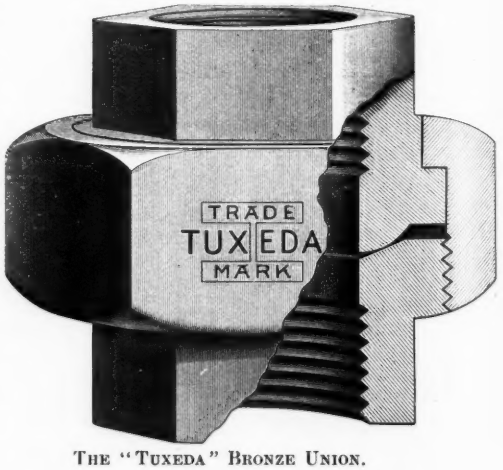
The problem of securing tight joints becomes more and more difficult of solution as higher steam pressures are used and as higher temperatures become necessary. The union connecting the ends of pipes is often a weak point in a plant and may cause considerable annoyance and trouble.

The Tuxeda Manufacturing Company, 39 Cortlandt street, New York city, has placed upon the market a form of union which has been designed especially for high-temperature and high-pressure work. It is made of "Tuxeda" bronze, a special alloy which possesses unusual soundness and high tensile strength. The design shows full appreciation of the exacting requirements of this special service.

Extremely heavy ends are turned, preventing any spreading. These ends are hexagonal in shape, so that they may be conveniently and quickly manipulated by a smooth-faced wrench without danger of having the edges worn down by the slipping of a monkey-wrench or damaged by the jaws of a Stillson.

The joint is made by a slightly tapered seat, to which is fitted a nose that is rounded and well ground, so that a positive surface of contact is always assured, even if the pipes are out of alignment. This self-seating feature of the union prevents any trouble arising from unequal expansions and deflections of pipes.

These unions are made in sizes up to four inches, and will stand the severest service. They are designed with long and accurately cut threads, and, due to this feature and their general strength and solidity, can be changed about and used over and over again without destroying their effectiveness.



THE "TUXEDA" BRONZE UNION.

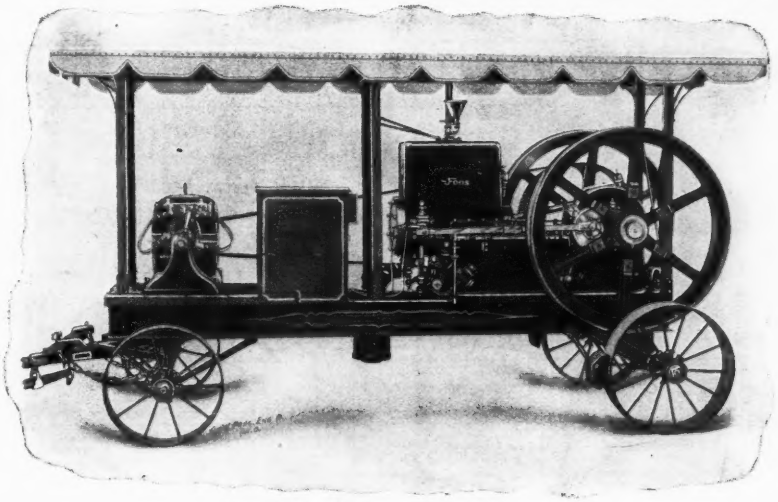
These joints are now being specified by some of the leading engineering firms, which are making sure that the selection of an interior union shall not contribute to a defect in the finished pipe line.

The unions are especially well adapted to drip piping and oiling systems, for use with superheated steam, and for withstanding the action of acids in smelting and mining plants.

A Portable Electric Power Plant.

As the gasoline engine becomes better understood by the public, manufacturers naturally develop a broader line of combinations. A new scheme recently offered by the Foos Gas Engine Company, of Springfield, Ohio, and of which a considerable number have been sold is illustrated herewith.

This outfit consists of a twenty-two-horse-power Foos gasoline engine belted to a dynamo of corresponding capacity, and it is entirely self-contained, there being no accessory tanks, batteries or other details. It is mounted on a steel truck, and can be furnished with or without top and curtains. Such a portable plant may be employed to great advantage in operating electric tools, for temporary electric lighting, thawing frozen water pipes, running coal loaders, electric hoists and other contractors' apparatus and for numberless other purposes.



PORTABLE ELECTRIC POWER PLANT.

The gasoline engine is of the regular Foos portable type. The cylinder and water-jackets are of special design and carry a sufficient supply of water to properly cool the cylinder. The water has a free passage to the air and maintains a uniform temperature, requiring no attention except that a bucket of water must be added occasionally to make up the loss due to evaporation. The cylinder is equipped with a complete water-glass by which the height of water may be gauged. This method of cooling the cylinder does away with the cumbersome water tank and the circulating water and fans often employed, and the advantages gained by freedom from water pipes and connections which may freeze or be broken by the vibration of operating and hauling over rough roads, can not be too strongly emphasized.

The Foos gas and gasoline engines are designed on the well-known four-cycle principle, giving an impulse at alternate revolutions of the flywheels. Nearly all the principal working parts being assembled on one side, the operator is enabled to install the engine to the best advantage, and to have free access to the devices for starting and for regulating speed, fuel and air supply, and time of ignition.

The system of ignition, on which depends in such a large measure the steady running and effective operation of an internal-combustion motor, has been very ingeniously worked out in these engines. The Foos igniter consists of two independent electrodes, the stationary and the revolving, each carrying a steel contact-piece. The revolving blade coming in contact with the stationary spring at each revolution emits a large electric spark, while at the same time the wiping action of the two parts removes any deposit of burned carbon or scale and prevents the incrustation of the contact edges, which is often the case of so much trouble. This rubbing action of the Foos igniter keeps the points of contact brightly polished under all conditions of operation and thus ensures continuous and even ignition. The blade and spring are in frictional contact for their full width of about half an inch, and this large contact surface, together with the hardness of the special steel used, makes them very durable. Adjustment for wear is made by simply loosening a locknut and moving the stationary electrode screw one-half turn or more toward the revolving electrode, and, when necessary, the blades can be renewed quickly and at trifling cost.

The Foos governor is simple and compact, is so designed that it may be adjusted to any speed required while in operation. It is of the centrifugal type and regulates the supply of fuel by cutting out the charges beyond those required to maintain the proper speed. Plain poppet valves, having vertical motion transmitted positively to both valves, are used.

Another feature of the Foos engine is the system of counterbalancing, in which discs are bolted to the arms of the crank, thus leaving the flywheels in balance, the latter having no weights cast in their rims, and bringing the counterbalancing weights in direct line with the piston, connecting rod, crank and other parts to be balanced.

The material is carefully selected, phosphor-bronze being used in all main bearings, and steel forgings for connecting rod, crank and such parts.

The design of the Foos engine is such as to make all parts fully accessible, it being possible to remove either valve, either portion of the igniter, the cylinder head, piston and so on, without disturbing any other part of the engine, or any pipe, fittings or connections. The workmanship is of a very high grade, and the facilities of the large Foos factory, which is fully equipped with up-to-date and special tools, are most excellent.

Some Notable Allis-Chalmers Literature.

The Allis-Chalmers Company, Milwaukee, Wis., during the past year issued a number of very handsome and instructive books bearing upon its various products.

"The Book of the Four Powers" briefly sets forth the scope of the Allis-Chalmers manufactures and gives a short-range view of the application of steam, gas, water and electricity.

"The Power of the New York Subway" describes the part played by one of the Allis-Chalmers four powers in the underground rapid transit system of New York.

The Allis-Chalmers Company has become the sole licensee in North America for the manufacture and sale of the world-famous dynamos, turbines, governors and other hydraulic machinery of Escher, Wyss & Company, of Zurich, Switzerland. The book describing hydraulic turbines and governors is replete with interesting information and handsome illustrations.

Another book is catalogue No. 110, describing the style K Gates rock and ore breakers.

Any one of these books is a worthy addition to an engineering library. The Allis-Chalmers Company has spared neither expense nor effort to make them attractive, both from a typographical and mechanical standpoint.

The Westinghouse No. 92-A Railway Motor.

The Westinghouse No. 92-A railway motor is designed to perform that class of service to which the No. 49 has heretofore been applied. In general design it closely resembles the Westinghouse Nos. 93 and 101-B, and incorporates the many improvements which were first introduced in those motors.

This motor is designed for city and suburban service. In city service a double equipment of these motors is suitable for operating single or double-truck cars, not exceeding thirty feet over all, and weighing, without equipment or load, from 14,000 to 15,000 pounds. In this service, with runs from one-eighth to one-quarter mile in length, a two-motor equipment, with gear ratio of fourteen to sixty-eight, will produce schedule speeds of 10 to 13.5 miles per hour, assuming a pressure of 500 volts and a straight, level track. A four-motor equipment in the same service will operate a double-truck car not over forty feet in length and weighing 30,000 pounds, attaining practically the same schedule and maximum speeds as stated above.

The motor has a nominal rating of thirty-five horse-power for one hour, but this rating is only an approximate indication of its suitability for a given service. The curve herewith shows the performance characteristics for one-gear ratio, and the performance curves furnish the proper data for judging of the operation of the motor in a given service.

The No. 92-A motor has a continuous capacity of thirty amperes at 300 volts, or twenty-eight amperes at 400 volts. In service it will safely develop any output shown on the curves, provided the integrated heating effect does not exceed that produced by continuous operation at a load requiring either of the above currents at the corresponding voltage.

At the close of a shop run of twenty-four hours, at either of the loads stated above, the temperature rise in the windings, as measured by a thermometer, will not exceed seventy-five degrees centigrade. In actual service under a car the better ventilation will usually reduce this rise to fifty-five degrees centigrade. Heavier loads may be carried for periods of varying length, as determined by the time-temperature curves, these curves being based on a rise of twenty degrees centigrade in the interior of the motor coils.

The frame is approximately cylindrical in shape; it consists of two castings of high-grade steel, accurately milled on the common surface to secure a good joint. The side away from the axle is provided with hinges, which allow the lower frame to be swung downward. The armature may be swung down with the lower part, or may be retained in the upper frame; this arrangement gives access to every part of the motor for inspection or repair.

Ready access to the commutator and brush-holders is provided by a large opening in the upper frame, this opening is closed by a dustproof lid, held in place by a cam-locking device. Hand and peep-holes are provided for inspecting the lower field, and these are also closed by water-tight covers. Both upper and lower castings are provided with bales for handling the motor.

There are four poles projecting inward at angles of forty-five degrees with the horizontal. Each is built up of carefully annealed soft steel punchings, riveted together between end-plates of wrought iron and bolted to the frame. The retaining-studs pass well into the punchings and terminate in a special rivet. This arrangement holds the pole firmly, yet leaves the pole-face smooth and unbroken.

The field coils are wound with copper strap, insulated with asbestos and mica, and protected by several layers of tape. They are repeatedly dipped and dried, and thoroughly impregnated, the process resulting in a solid coil, thoroughly weatherproof and practically indestructible. The coils are straight and interchangeable. Flat steel springs between coils and frame prevent looseness due to shrinkage. The coils are protected by leatheroid and oiled duck washers, and are held in place by the spreading tips of the poles. The field connections are made to terminals, one being brought out at each side of the coil. The end of the coil is thoroughly bound down when the terminal is brought out.

The armature is of the slotted drum type. It is built up of circular punchings of soft steel, built up on a cast-iron spider and held between end-plates. The steel in every armature is carefully annealed by a process which gives it permanent magnetic qualities. The punchings rest on ridges on the spider, and the grooves between the ridges are open to the air at the pinion end. Air-ducts between the stampings connect with

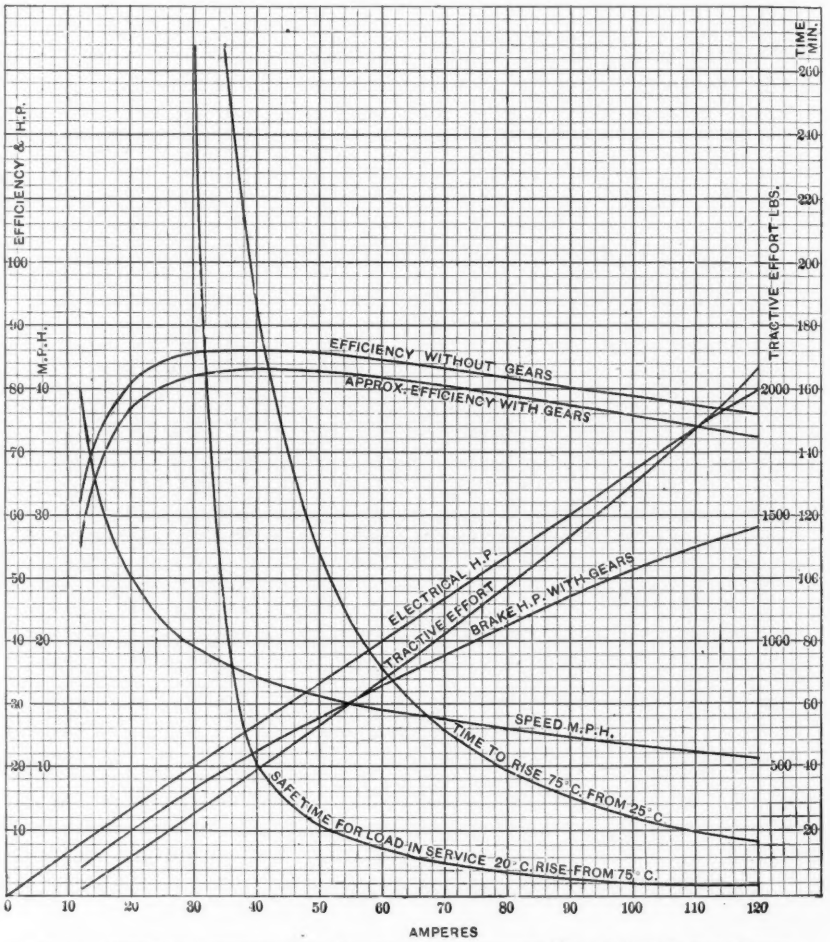


FIG. 1.—GENERAL PERFORMANCE CURVES, WESTINGHOUSE NO. 92-A RAILWAY MOTOR.

these grooves, and thus air is continually drawn in through them and forced out against the pole-pieces and field coils, producing a uniform temperature throughout.

Machine-wound armature coils are used, with insulation of a very high factor of safety, and are imbedded in rectangular slots in the armature. The coils are held in the slots both by retaining-wedges of hard fibre, driven into V-shaped grooves near the top of the slots, and by hand wires, making them doubly secure. The ends of the winding outside the armature core are covered with specially prepared canvas covers and wide bands, and rest at each end on flanges, which act as a support for them. The wide bands placed at either end of the winding, together with the fibre wedges, canvas coverings and the bell-shaped iron flange at the pinion end, form a most excellent protection against mechanical injury, as well as moisture. The diameter of the armature is thirteen inches.

The commutator is of the straight bar type, without necks, and is built up with 123 bars of hard-drawn copper, separated by segments of soft amber mica, and clamped on a bushing between V-shaped surfaces from which they are insulated by specially moulded mica. The wearing surface is nine inches in diameter and nine-sixteenths inch long. The wearing depth is fully five-eighths of an inch. The complete commutator is forced on the armature spider under pressure, and prevented from turning upon it by a steel key. Two cast-brass arms, firmly fastened to the upper frame by bolts, carry the brushes. They are well insulated by means of washers of treated fullers' board, and radial adjustment is provided to compensate for wear of the commutator. The holders are of the sliding type. Each arm carries two spiral brush springs, each of which bears upon a separate brush. The two brushes move side by side in the slot, and each extends half-way across the face of the commutator. This arrangement reduces the weight of each brush and moving element, so that it follows very closely the surface of the commutator, with an entire absence of "chattering." The shunts are of braided copper, and extend from each brush spring-tip to the arm, preventing the current from passing through the spring, the springs being so mounted as to be practically frictionless and very sensitive to movements of the commutator. The brushes are of copper-plated carbon, and each is one-half inch by one and one-half inches in section.

Leads of flexible rubber-covered cable are brought out through semi-soft rubber bushings set in the motor frame. All outside connections are made with knuckle joints.

The bearing at the commutator end is six and one-half inches long and three inches bore, and that at the pinion end seven and one-half inches long and three inches bore. Each bearing consists of a cast-iron bushing in one piece, lined with babbitt. Each bearing is carried in a housing of cast iron, the seat of which is turned to a cylindrical shape and is clamped between similar surfaces on the two halves of the frame. Each housing has a finished flange on the inner end, which fits against a finished surface on the field frame, taking the entire end thrust of the armature. The housings are held in place by tap-bolts, extending through the upper and lower frames. Each bearing is held from turning by a key.

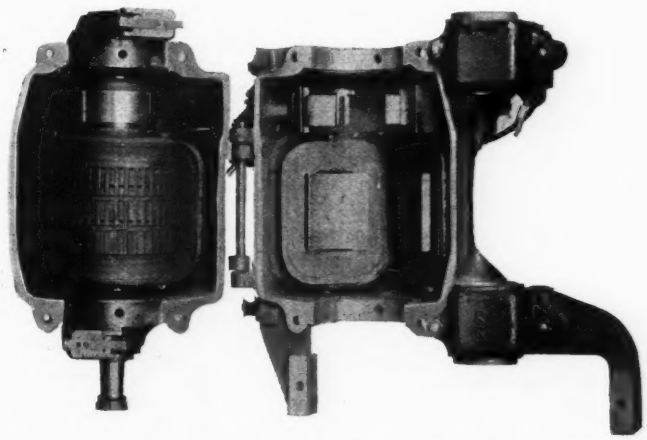


FIG. 2.—RAILWAY MOTOR, FIELD OPEN, SHOWING ARMATURE.

These housings contain oil and waste reservoirs, covered by metal caps held by springs. The reservoirs are on the low-pressure side of the bearings, and allow the saturated waste to come in contact with the armature-shaft through large openings. There is a separate space in the housing, through which the depth of oil may be readily measured, and the free oil added. The inner end of each housing is extended to include wiper rings or oil guards forced on the armature-shaft, thus preventing oil from working along to the armature, and draining the oil into a separate well in the bottom of the housing.

The axle bearings consist of cast-iron shells, divided horizontally and lined with babbitt metal. Each is eight inches long, and may be made for any diameter of axle up to five inches. The bearings are held in place by cast-steel axle caps, bolted from below to projections on the upper frame. Lubrication is obtained in a manner similar to that used for the armature bearings. Each axle cap contains an oil and waste reservoir, which registers with an opening through the top half of the frame, the oil being fed to the axle through an opening in the lower half of the bearing.

The motor is designed for cross-bar suspension. A rectangular suspension bar supported over the truck frame is bolted to special lugs on the front corners of the upper field frame.

A pinion of forged steel with machine-cut teeth is keyed to the shaft, and held on a taper seat by a nut and lock washer. The gear is made of cast steel in two parts, which are bolted together and keyed to the axle. The face is five inches. Gear ratios of 15:69, 18:66 and 22:62 are standard.

The gear case is made of malleable iron in two castings. The two parts are fastened together with lugs and bolts, and to the extension lugs on the upper frame at front and rear ends. This arrangement is particularly good, as no strains can be thrown on the gear case by vibration between upper and lower frames, the case being fastened to only one-half. The supporting lugs are especially strong and heavy, and are particularly well adapted to the use of malleable or sheet-metal cases. The whole gear case is carefully made, and will bear very hard service. The gears may be run in oil if desired.

The approximate weights of the No. 92-A motor are as follows:

Motor alone, without gears and gear case, 1,995 pounds.

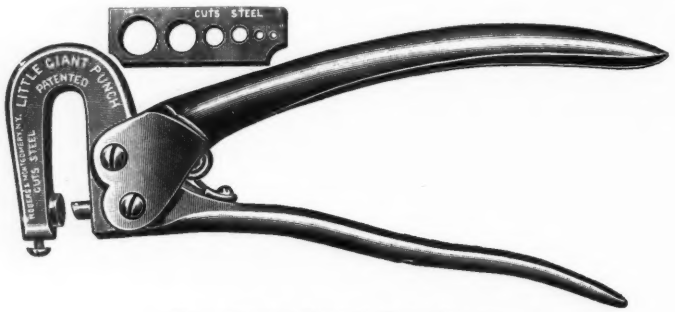
Motor complete, with gears and gear case, 2,320 pounds.

Armature complete, with commutator and windings, 475 pounds.

The approximate weight of a two-motor equipment, with two controllers and the usual details, is 5,680 pounds. A corresponding equipment of four motors, controllers, etc., will weigh approximately 10,900 pounds.

The "Little Giant" Hand Punch.

A new hand punch, shown herewith, is being placed on the market by Rogers & Montgomery, successors to the Rogers Manufacturing Company, 147 West Twenty-third street, New York city.



THE "LITTLE GIANT" HAND PUNCH.

This punch, which is called the "Little Giant" (Zacharias patent), is at present made in two sizes: No. 1 for punching holes from one-sixteenth to seven-thirty-seconds inch diameter, and No. 2 for holes of from one-quarter to one-half inch, inclusive. The No. 1 punch, which is shown in the cut, is guaranteed to easily punch a clean three-sixteenths-inch hole through 20-gauge sheet steel or galvanized iron, or 16-gauge sheet brass or copper.

In addition to punching sheet metals the punches are also especially adapted for punching leather, cloth, celluloid, slate, wood, bamboo, rubber, books or paper of any thickness up to the width of the opening between punch and die, so that the many time-saving uses to which a quick-working hand punch of this type may be put will readily suggest themselves. The design of the punch is such as to give an unusually great leverage, as a pressure of one pound exerted on the handles gives fourteen pounds at the point of the punch, and it is this great leverage, together with the high-class materials and workmanship, which enables these hand punches to do work of many kinds requiring the use of a punch press or drill press.

Both the Nos. 1 and 2 punches are seven inches over all, with the No. 2 having a slightly enlarged head to admit the larger sizes of punches and dies. Interchangeable sets of the punches and dies, of each separate one thirty-second inch diameter from one-sixteenth to seven-thirty-seconds inch, may be had for the No. 1 punch; and of each separate one-sixteenth in diameter from one-quarter to one-half inch, inclusive, for the No. 2. Any intermediate size of punch and die, different in diameter from those mentioned, may be had on special order.

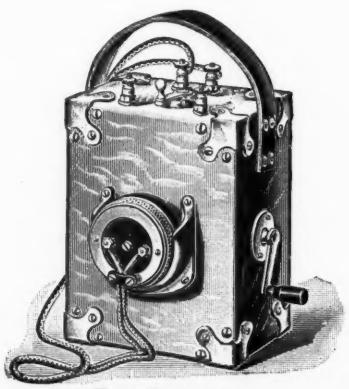
The parts are drop-forged from steel, the assembling screws case-hardened, the punches and dies made from tool steel, properly tempered and hardened, the tool polished and heavily nickel-plated and fitted with coil-wire spring for expanding the handles. A sample of this punch will be sent on approval to any reliable concern making the request. If not satisfactory the punch may be returned charges collect.

New Telephone Apparatus from the Connecticut Telephone and Electric Company.

The Connecticut Telephone and Electric Company, Meriden, Ct., is placing on the market a new automatic branch exchange telephone and a new Bell style test telephone. The automatic system is designed for branch office exchange work, in connection with both magneto and common battery city service. With this apparatus each party makes his own connections, eliminating the services of a private line switchboard operator. When a call is to be sent from one department to another of a factory, or from the office to any part of a factory, the calling party pushes down the button corresponding to the department wanted. The pushing down of the button automatically cuts in the party and calls. When the conversation is finished and the receiver is returned to the hook, the party called is automatically cut off the line. City central can be called direct from any point in the system. This system is particularly designed for connection to common battery city service.

AUTOMATIC BRANCH EXCHANGE TELEPHONE.

The No. 1 button may be designated as the exchange button throughout the system if outside service is desired. To call central it is necessary to press down the exchange button and remove the receiver in the regular way, thus making a visual signal at central. When the conversation is finished the button is automatically reset to its former position. In this way there is established an intercommunicating system between any department or office in the building in which the exchange is installed, as well as automatic city service connection.



TEST TELEPHONE.

The connections in this instrument are made on hard rubber, and the transmitter, receiver and working parts are of the best design. The switching device is built to stand heavy use and all conditions of temperature. The trip is of case-hardened steel, and the possible chance for wear is very slight.

The Bell style test telephone is made up on the same general line as the Bell telephone test sets. The case contains a generator and polarized buzzer. The receiver is placed in a clip in a socket on the side of the case, a two-point switch

being used for cutting in the generator or receiver, as required. No batteries are required, as the receiver is used for both transmitter and receiver. The receiver in this set is of an extra large and powerful design.

The Connecticut Telephone and Electric Company is placing on the market a new style of test instrument, which has a complete telephone equipment, with its latest solid back transmitter, watch-case receiver, generator, ringer and two cells of pocket dry battery. This instrument will work over any distance, and is suitable for testing electric light, telegraph and telephone lines, cables, wiring and buildings. The instrument is also in general use in the army, and is used as a street railway telephone. Plug and weatherproof jack boxes are furnished for mounting on poles. Both of the last described instruments are made in two sizes, the largest being for heavily loaded toll lines.

Skeleton Bells.

Stanley & Patterson, 40 Cortlandt street, New York city, have placed upon the market a new form of skeleton bell

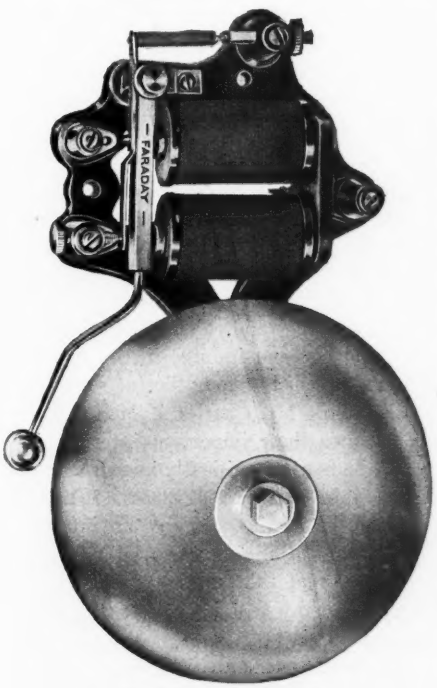


FIG. 1.—SKELETON BELL.

which is designated as the "Faraday," and for which is claimed a number of meritorious features.

Special care has been taken in the manufacture of these skeleton bells to eliminate any possibility of the loosening or moving of the trunnion frame, the turning of a contact post, or the working loose of the core from the yoke.

The trunnion frame is held in place by two screws, one of which, passing through the bell, is secured into the trunnion

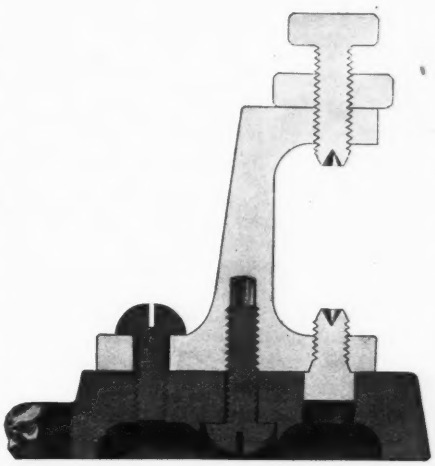


FIG. 2.—TRUNNION FOR SKELETON BELL.

frame; the other, passing through the trunnion frame, is secured into the bell frame. It would be necessary for both of these screws, forced into the casting in opposite directions, to work loose to result in a change of position of the trunnion.

The trunnion bearings in this bell are also arranged so as to eliminate the possibility of working loose. Both the upper and lower trunnion bearings are sixty-degree, tapered cones, into which are fitted the steel trunnions. The lower bearing is forced into the bronze casting of which the trunnion frame is made under such pressure as to make impossible any loosening.

The duplex side contact post is a patented feature of the "Faraday" skeleton bells. This post carries the platinum-pointed screw, and is attached to the frame of the bell so as to preclude the possibility of turning. The contact post is held in place by two screws, one of which has no wire underneath and may be driven home as hard as desired; the other screw can be tightened so as to hold the wire in place, but is independent as a necessity for holding the contact post to the frame. It, however, forms an additional safeguard to prevent the turning of the contact post.

Special attention has been given to the construction of the cores in this bell. The cores are made of cold-drawn Norway iron, thoroughly annealed after machining. The ends are formed into a tapered shoulder which is forced into a reamed hole against a counterbored surface in the back yoke. This makes a highly efficient magnetic connection. Screws are provided to securely fasten the cores to the back yoke.

The armature is milled out to receive the contact spring and adjusting spring strap. The spring strap is fastened over the contact spring with two screws. The removal of these two screws is all that is necessary to take off the contact spring should new platinum points be required.

Pure phosphor bronze is used for the tension-adjusting springs, and the same metal is used for the contact spring.

To prevent the gong from turning the gong post is provided with four ribs at right angles. These ribs fit into four incisions in the gong. The gong is held in place by a hexagonal screw milled from a solid bar.

The gong castings are made from pure bell metal.

The hammer ball is riveted on to the hammer wire, and the hammer wire is, in turn, riveted and pinned into the armature.

The frame is heavily ribbed to prevent the possible breaking of the casting when it is screwed on to an uneven wall. The frame is also provided with lugs so that the bell can be placed on a plaster wall without making indentations.

The contact points are made of pure platinum, and riveted in. The connecting wires are encased in a rubber tube protected on the outside by a braided and waterproofed reenforced covering. The

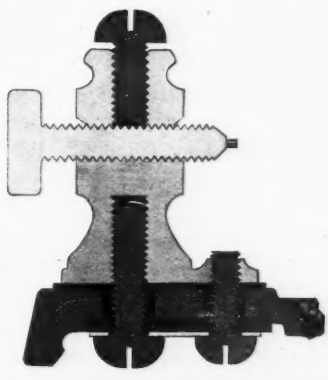


FIG. 3 —CONTACT POST FOR SKELETON BELL.

connecting screws are soldered or held in place under a non-turning washer.

All of the parts of the "Faraday" skeleton bell are made to gauge, and can be interchanged without being adjusted, fitted or filed.

Fort Wayne Electric Agents' Convention.

The Fort Wayne Electric Works, Fort Wayne, Ind., is one of the oldest concerns in this country now engaged in the manufacture of electric lighting and power apparatus. It is probably best known to the electrical interests of the United States, if not the world, as the manufacturer of the "Wood" systems of electric lighting and power which may be found in use in thousands of plants in this country. "Wood" electric lighting generators and arc lamps were among the pioneers in the industry and have always maintained the distinction of receiving a ready reception from the users of that class of apparatus.

The original company from which the present concern has been developed was formed in Fort Wayne, in 1881, to manufacture electric lighting apparatus and was called the Fort Wayne Electric Light Company. Its history has been marked by successive changes in name from the original name to Fort Wayne Electric Company in 1889, Fort Wayne Electric Corporation in 1894 and to the present name in 1899.

The part this company has taken in the development of the electrical manufacturing industry of this country has been in no small way due to the thorough and skilled designing ability of Mr. J. J. Wood, who is to-day recognized as one of the foremost inventors in the arc-lighting field of this country, in which he was a pioneer in 1879. Modern demands on electrical engineers, both in the lighting and the power applications of electricity, have been met and often anticipated by his tireless genius and strong personality showing in the products of the Fort Wayne Electric Works.

The extent of territory covered by the sales organization reaches from Boston to San Francisco and from St. Paul to Atlanta. The modern methods of a progressive business enterprise are well illustrated by the periodic conventions of the district managers of the various territories with the home office organization of this company.

Beginning Tuesday morning, January 10, 1905, and closing on Friday following, the daily business sessions of the sales forces have been relieved by evening social functions of a very enjoyable nature. Representatives from Boston, New York, Philadelphia, Syracuse, Pittsburg, Atlanta, Cincinnati, Grand Rapids, Chicago, St. Paul and St. Louis have discussed matters of common interest right on the ground of the central organization.

The social features of the convention were distributed over the period covered by the sessions, several of the Fort Wayne hosts entertaining the visitors at their homes.

The closing feature of the convention was a banquet at the Anthony Wayne Club at which over fifty of the sales force joined in disposing of a bounteous repast presided over by Judge R. S. Taylor, who has been counsel for the company ever since its infancy. Guests from the city included the local directors and others interested in local electrical organizations.

Those from the district offices attending the banquet were as follows:

J. Allan Smith, Boston, Mass.; J. C. Lott, New York, N. Y.; T. L. Sturgeon, Philadelphia, Pa.; C. A. Woolsey, Philadelphia, Pa.; E. H. Porter, Philadelphia, Pa.; A. E. Dresser, Syracuse, N. Y.; F. S. Nicholson, Syracuse, N. Y.; J. E. Hall, Pittsburg, Pa.; T. J. Ryan, Cincinnati, Ohio; G. B. Edgar, Cincinnati, Ohio; James O. Spear, Atlanta, Ga.; W. S. Goll, Chicago, Ill.; Frank McMaster, Chicago, Ill.; C. E. Sedgwick, Chicago, Ill.; W. C. Knight, St. Louis, Mo.; A. H. Savage, St. Paul, Minn.; A. L. Searles, Grand Rapids, Mich.

During the evening the district managers, as an expression of their appreciation and esteem for the one who is responsible for the products they handle, presented Mr. J. J. Wood with a handsome loving cup through their spokesman, Mr. W. S. Goll, manager of the Chicago office.

Mr. Wood has been with the Fort Wayne company since 1890, when he went to Fort Wayne from Brooklyn where he was manufacturing his arc lamps and dynamos when the Fort Wayne company purchased the Brooklyn plant and Mr. Wood transferred its machinery and men for making his arc-lighting apparatus to Fort Wayne. He immediately assumed charge of designing new electrical apparatus and redesigning the old apparatus and electrical devices already in production by the company.

Numerous new designs were the result of his inventive genius and electric lighting supplies were made in a more perfected form than ever before. The company advanced rapidly in the electrical manufacturing field and "Wood" systems became very widely used in electric lighting and power.

Mr. Henry S. Manning Retires from the Firm of Manning, Maxwell & Moore.

On January 9, 1905, Mr. Henry S. Manning sold to Mr. Charles A. Moore his entire interest in the firm of Manning, Maxwell & Moore, together with his ininterests in the various manufacturing concerns, *viz.*, the Ashcroft Manufacturing Company, the Consolidated Safety Valve Company, Hayden & Derby Manufacturing Company and the Hancock Inspirator Company. There will be no change in the name or character of the firm of Manning, Maxwell & Moore, and its business in the future will be conducted by Mr. Moore and the gentlemen who have been associated with him.

In 1873 the firm of H. S. Manning & Company was started. This company was succeeded by the firm of Manning, Maxwell & Moore in 1881. The growth of the business has been steady and constant, and the firm now has branches in Chicago, Cleveland, St. Louis, Boston, Pittsburg and Philadelphia. Various manufacturing interests have been acquired, so that to-day the firm is interested in the manufacturing industries of the Ashcroft Manufacturing Company, manufacturer of steam gauges, indicators and pipe-fitting tools; the Consolidated Safety Valve Company, manufacturer of safety specialties, the Hayden & Derby Manufacturing Company, manufacturer of "Metropolitan" injectors and ejectors; the Hancock Inspirator Company, manufacturer of Hancock separators and valves of various kinds, and the Shaw Electric Crane Company, manufacturer of electric traveling cranes.

Mr. Manning retires from the firm so that he may be relieved of business cares and problems, and indulge in the recreation to which his long business career entitles him. Mr. Charles A. Moore, who thus secures these important interests, is one of the most prominently known manufacturers in the United States, and the fact that he retains so great an interest in the firm of Manning, Maxwell & Moore guarantees that the product of this well-known company will be maintained at a high standard.

Mr. F. F. Proctor has secured for the Proctor circuit of theatres an important European specialty in the form of the "Phono-Bioscope," a combination of the motion picture machine and the phonograph, invented by a German, Herr Noggrath. This promises to create a great sensation, and is said to be the best machine of its kind ever invented.

CURRENT ELECTRICAL NEWS

DOMESTIC AND EXPORT.

CEBU, P. I., TO HAVE AN ELECTRIC LIGHT PLANT—It is announced that Cebu, the most important port in the Philippines next to Manila, is soon to have an electric lighting plant. A telephone system, said to be the best of any city in the Far East, is already installed.

COMPROMISE WITH NORTH AND WEST CHICAGO TRACTION COMPANIES—A compromise has been effected between Union Traction interests and the stockholders of North and West Chicago street railroad companies. Judge Grosscup has rendered a compromise verdict, authorizing the issue of $500,000 receivers' certificates, not liens on underlying companies.

NEW POWER PLANT FOR CALUMET & HECLA—A power plant for the use of the Calumet & Hecla mine is to be erected at Hubbell, Mich. The plant will supply 10,000 horse-power. Electricity will be used for all the operations in the mines, and the company anticipates a large economy in operation. About one year will be required for the completion of the plant.

BOSTON ALDERMEN VOTE FOR MUNICIPAL OWNERSHIP OF CITY LIGHTING—The new board of aldermen has passed an order authorizing the city of Boston to acquire and maintain plants for the manufacture and distribution of gas and electricity for lighting purposes. The vote was nine to three. In passing the municipal gas plant order the board followed the example of the common council, which has gone on record as heartily in favor of the plan.

CENTRAL LIGHTING PLANT PROPOSED IN WASHINGTON, D. C.—Mr. Bernard G. Green has submitted to Speaker Cannon a report recommending the construction of a power plant to supply all the government buildings in the vicinity of the White House with light and power. The plan provides for the removal of all engines and boilers from the buildings mentioned. The estimated cost of the plant is $2,000,000 and the annual expense for maintenance and operation is estimated at $200,000.

ELECTRIC LIGHT PLANT AT GUADALAJARA, MEXICO—A concession has been granted for the construction of electric tramways in the city of Guadalajara and suburbs. A company has been organized to do the work by Senor Hamon, Alcazar, of Mexico City. The company will pay to the Guadalajara city treasury the sum of $400,000 in eight yearly instalments of $50,000, which will be used by the city to construct an arch viaduct over the San de Dios river, which will be used by the tramways. The company intends to start work as soon as possible.

NEW HYDROELECTRIC PLANT STARTED UP IN CALIFORNIA—The new plant of the North Mountain Power Company, of California, was started on December 31. The power-house is located at Junction City, and the present installation consists of two 750-kilowatt, twenty-five-cycle, three-phase, alternating-current generators, direct-coupled to Pelton wheels. The effective head of water is 600 feet. The line is seventy-five miles long and runs to Eureka. The entire line and plant were built in six months. Mr. George T. Ruddack is general manager of the company.

MERGER OF ELECTRICAL COMPANIES IN CANADA—Steps have been taken to merge the different electrical and power interests operating in and around Ottawa, Quebec. The scheme contemplates uniting the Ottawa Electric Company, the Ottawa Electric Railway, the Consumers' Electric Company, the Hull Electric Company, including the street railway of that city, the Capital Power Company, of Deschene, the Hull & Ottawa Power Company, and probably the Metropolitan Electric Company. The scheme also involves the development of the water power of the Chaudiere and the details of this have been decided upon. There is an admirable power at Brittania, owned by the Metropolitan company, but it has only partially been developed. It is intended under the scheme outlined to develop this also, when necessary. The combined capital of the companies involved is about $7,000,000.

CHICAGO DIRECTORS OF THE ILLINOIS TUNNEL COMPANY—The Chicago Subway Company, which owns the stock of the Illinois Tunnel Company, the Illinois Telephone and Construction Company, and the Chicago Warehouse and Terminal Company, has announced that the following men will be in the directory of the Illinois Tunnel Company, which will operate the subway: A. J. Earling, president, Chicago, Milwaukee & St. Paul Railway; E. P. Ripley, president, Santa Fe Railway; George H. Harris, president, Chicago, Burlington & Quincy Railroad; S. M. Felton, Chicago & Alton Railway; J. Kruttschnitt, director of maintenance and ways, Southern Pacific and Union Pacific railways; B. L. Winchell, president, Rock Island Railway; C. A. Bird, vice-president, Gould lines; F. D. Underwood, president of the Erie Railroad; Benjamin Thomas, president of the Chicago & Western Indiana Railway; P. A. Valentine, vice-president of Armour & Company; Alfred B. Wheeler, president of the Illinois Tunnel Company. Among additional directors who will be announced later will be representatives of the Vanderbilt lines, the Pennsylvania Railroad and the Chicago & Southwestern Railway.

POWER PLANT IN MICHIGAN—A new company has been formed to build and operate power stations on the White river, Mich., which will make use of the power of that river for generating electric current for transmission to the cities of Whitehall, Fremont, Montague and Muskegon. The capital is said to be $1,500,000, and those interested in the enterprise are M. B. Wheeler, A. O. Wheeler, R. H. Opdyke and Wesley W. Hyde, together with several other Grand Rapids men and New York capitalists. Two dams are to be built, one of which will be located about seven miles above Whitehall, and it is proposed that sufficient water shall be backed up at this point to provide a constant supply of 4,000 horse-power throughout the year. The other dam will be located further up stream and will develop 3,000 horse-power. The work of building the first dam is to be started in the early spring, and it will be completed in the shortest time possible. The present plans contemplate furnishing electricity to one of the above-mentioned cities by January next. The dam is to have a height of sixty feet. It is estimated that the cost of the entire equipment will be in excess of $1,000,000. The flowage rights for the tract of land through which this river flows, and the property which is adjacent thereto, have been secured, and the timber will be removed during the winter. Messrs. Bates & Neilson, consulting electrical engineers, 42 Broadway, New York city, are associated with this enterprise.

NEW PUBLICATIONS.

PUBLICATIONS OF THE UNITED STATES NAVY DEPARTMENT—The United States navy department has issued the following publications: "Annual Report of the Secretary of the Navy," "Annual Report of the Chief of the Bureau of Equipment," "Annual Report of the Chief of the Bureau of Ordnance," "Annual Report of the Chief of the Bureau of Navigation," "Annual Report of the Chief of the Bureau of Steam Engineering," "Annual Report of the Chief of the Bureau of Construction and Repair," "Annual Report of the Chief of the Bureau of Yards and Docks," "Annual Report of the Surgeon-General of the United States Navy," "Annual Report of the Brigadier-General Commandant of the United States Marine Corps," and the "Annual Report of the Judge-Advocate-General to the Secretary of the Navy."

WINDMILLS IN FOREIGN COUNTRIES—The department of commerce and labor, bureau of statistics, Washington, D. C., has issued special consular reports, vol. 31, entitled "Windmills in Foreign Countries." It contains reports from consuls all over the world, and treats of the windmills in use, the climatic conditions as regards windmills, water supply, wells and pumps, irrigation and farming methods, the duty on windmills, the transportation and freight rates, and the outlook for American windmills in all of the foreign countries.

ELECTRIC LIGHTING.

LITTLE ROCK, ARK.—E. T. McConnell is making arrangements to build an electric light plant for Clarksville.

TRENTON, N. J.—The Carteret Electric Light and Power Company, of Carteret, has been granted a perpetual charter.

CEDAR FALLS, IOWA—Cedar Falls has voted to grant a franchise to the Waterloo & Cedar Falls Gas and Electric Company.

HARTFORD, KY.—J. W. Hale, of Fordsville, has contracted with the town council to install fifty lights for street lighting.

LITTLE ROCK, ARK.—A contract has been awarded to the Black Hawk Electric Company, of Davenport, Iowa, for the erection of an electric light plant at Searcy.

STRATFORD, N. J.—Extensions of the electric light system of the Clementon Township United Electric Company are being made to Stratford, Kirkwood and Lindenwold.

OSWEGO, N. Y.—The Oswego department of works has awarded the contract for lighting the city for the next five years to the People's Gas and Electric Company. The price paid will be $66 per lamp.

READING, PA.—The Keystone Electric Light, Heat and Power Company, of Kutztown, has placed an order with the General Electric Company, in Schenectady, N. Y., for an electric light dynamo double the capacity of the one in use.

LYONS, N. Y.—The Palmyra Electric Light and Power Company's plant has been purchased by William T. Morris, of Penn Yan, who is the head of a syndicate owning lighting plants in Lyons, Newark, Penn Yan, Oneida and Ithaca.

MARKSVILLE, LA.—The election on the question of levying a five-mill tax for twenty years for the purpose of installing a system of waterworks and electric lighting plant in Marksville, held recently, resulted in the tax being carried by a large majority.

SEYMOUR, CT.—The Seymour Electric Light Company has given notice of an application to the general assembly for amendment to its charter permitting an increase of capital to an amount not exceeding $100,000, providing for the issuance of bonds, etc.

ALAMEDA, CAL.—The Alameda city trustees have awarded the contract for furnishing a new engine for the municipal electric plant to the Charles C. Moore Company, of San Francisco. The same firm was also given the contract for providing the plant with a generator.

WHEELING, W. VA.—The Cameron Heat and Light Company's stockholders have elected a board of eleven directors, as follows: J. W. Dunlevy, C. E. Hutchinson, G. E. Hoffman, C. G. Fish, John Hagerman, W. M. Kincaid, W. M. Nowell, W. H. Loper, S. B. Hinerman, S. E. Leech and J. N. Howard.

NIAGARA FALLS, N. Y.—The Niagara Falls common council has granted a franchise to the Niagara Falls Gas and Electric Light Company to construct conduits in the streets, and also a franchise to the Niagara, Lockport & Ontario Power Company to erect poles and string wires within the city limits.

MINNEAPOLIS, MINN.—The Minneapolis city council has passed the lighting and power franchise of the Minnesota Power and Trolley Company. The ordinance gives a thirty-year franchise, with a graduated gross earnings tax, and limits prices for lighting to much below what have been charged.

COLUMBIA, KY.—Columbia is to have electric lights. Myers Brothers purchased the franchise, and operation on the plant will commence at an early date. One hundred lights, the required number to secure the plant, were readily disposed of, and others will be taken as the work progresses.

MADISONVILLE, KY.—There is a movement on foot to put in an electric plant at Morganfield large enough to furnish light for Morganfield, Uniontown, Sturgis, Waverly, Henshaw and a number of other towns located in a circuit of about twenty miles. Henry Oliver, of Fulton, is interested in the project.

UNION CITY, PA.—Negotiations for the purchase of the Climax Manufacturing Company's electric light plant, located in Union City, by home capitalists, have culminated in the transfer of the property to the Union City parties interested. The new company has elected a board of directors and will capitalize the plant at $25,000, with $20,000 paid in.

NAUGATUCK, CT.—The Danbury Power Company will ask the general assembly for a charter to establish a power plant on the Still river at Brookfield and New Milford, and to transmit electricity from the plant to Danbury, Bethel, Brookfield, Ridgefield and Redding. The plan is to dam the Rocky river in New Milford, just south of Jerusalem district, and the Still river at Lanesville and Brookfield.

BURLINGTON, VT.—The construction of a municipal electric light plant has been begun in Burlington. The building is already completed and several carloads of machinery have arrived. The plant complete will cost about $60,000. It will furnish about 200 arc lights, which is all the city uses, will light all of the city buildings, and will in addition leave about as much additional power for commercial uses.

CANAAN, CT.—The Berkshire Power Company, which has been organized with a capital stock of $240,000, will construct a dam and power-house on the Housatonic river at North Canaan. Preliminary work has already been commenced, and the undertaking will be pushed as rapidly as possible. Plans for the generation of a large amount of electric power to be distributed over a large area have been formulated.

SAN DIEGO, CAL.—Articles of incorporation of the United Light, Fuel and Power Company have been filed in San Diego, capitalized at half a million dollars, all subscribed, the majority of the stock being owned by John D. Spreckels, of San Francisco. The corporation is formed to construct and operate plants for making electric and gas light, fuel and power in the state of California, the principal business place being this city. There are five directors.

PORTLAND, ORE.—The Haines Electric Power Company, of Forest Grove, Ore., composed of prominent business men of Forest Grove, and of Portland, has recently been organized, and has taken over the interests of E. W. Haines and others in the electric light plant and mill at Forest Grove. The new company is capitalized for $50,000, divided into shares of $100 each. Among the stockholders are C. W. Nottingham, Ralph W. Hoyt, W. D. Haines, J. Frank Watson, John Thornburg. Headquarters of the company will be at Forest Grove.

HARRISBURG, PA.—A charter has been granted by the state department to the Commonwealth Electric Company, Philadelphia, with a capital of $100,000, to furnish light, heat and power to the city of Philadelphia. Appended to the charter application is a certificate stating that the company has renounced its original charter issued in New Jersey. The incorporators of the company are Mark Hyman, Herbert Scovill, New York; Ross A. Mackey, Brooklyn; Graham Sumner, Englewood, N. J.; E. D. Oakford, John M. Ingham and William M. Clift, Philadelphia. Mr. Hyman is president of the corporation.

HARTFORD, CT.—Lewis W. Ripley, for himself and others, has given notice that he will petition the general assembly for a charter incorporating the Glastonbury Power Company, for the purpose of making electricity and all forms of electrical force and power and of selling and distributing the same for any purpose within the limits of the towns of Glastonbury, East Hartford and Manchester, taking and using the water of Roaring brook and its tributaries in the town of Glastonbury. The charter is also to contain a provision that the corporation now existing under the name of the Glastonbury Power Company shall be merged in the chartered corporation.

KEARNEY, N. J.—The Kearney common council recently voted to erect a municipal plant to light the streets of the town. The lighting committee was authorized to engage an electrical engineer to prepare building plans and specifications for the plant. Estimates of the cost of erecting such a plant have been secured by the council, and it is believed that the total expense, including poles and wires, will be about $50,000. It is proposed to locate the plant upon the Passaic river at the foot of Johnston avenue. This action was taken after rejecting the offer of the Public Service Corporation to furnish arc lights to the city at a cost of $98 per lamp per year, which is a reduction of $2 on the price paid at present.

PERSONAL MENTION.

MR. H. P. BRUCE has been appointed manager of the Havana Electric Company, of Havana, Cuba, to succeed Mr. G. F. Greenwood, resigned.

COLONEL E. A. STEPHENS has been made manager of the Bell Telephone Company at Barnesville, Ga., and has taken charge of the business.

DR. GEORGE I. BETTS made an address on "Electricity and Its Relation to the Human Mind and Body" before the Milwaukee Literary Club at Mozart Hall, Milwaukee, Wis., on January 8.

COLONEL A. B. CHANDLER, chairman of the board, Postal Telegraph Company, was unanimously elected president of the Magnetic Club, New York, at the annual meeting held January 12, 1905.

MR. A. L. ENGLISH, of Omaha, Neb., will succeed Mr. W. P. Beyerle, who has resigned as manager of the Council Bluffs Citizens' Gas and Electric Company to accept the management of the lighting department of the Maryland Telegraph and Telephone Company.

MR. THEODORE P. BAILEY, assistant manager of the western office of the General Electric Company, left that company on January 1 to become vice-president and general manager of the L. E. Meyers Company, of Chicago. Mr. Bailey has been associated with General Electric interests for more than twenty years.

MR. C. J. PURDY has severed his connection with the Munder Electric Company as its New York sales agent to become general manager of the American Incandescent Lamp Company. He assumed his new position on January 16. The offices of the American Incandescent Lamp Company are at 26 Cortlandt street, New York.

MR. WILLIAM F. POTTER, vice-president of the Long Island Railroad, was elected president on January 13 to succeed the late William H. Baldwin, Jr. Mr. Potter has been connected with the road for eight years. He started as general superintendent, coming to that position from the Pere Marquette, where he was also general superintendent.

MR. HENRY C. MORTIMER, JR., of the General Electric Inspection Company, has joined the New York office staff of the Crocker-Wheeler Company. He will assist Mr. F. B. DeGress, manager of that office, and will succeed Mr. A. J. Thompson, who has accepted a position with the New York branch of the Bullock Electric Manufacturing Company.

MR. J. N. COX has been appointed electrical engineer by the Reading Company, with headquarters in Reading, Pa. He succeeds Mr. Ellis E. Brown, who will engage in the electrical business in Reading. Mr. Cox has been with the Reading for some years, having had charge of the electrical machinery at the Reading terminal, Philadelphia. He assumed his new position Monday, January 16.

PROFESSOR CHARLES L. HARRINGTON is giving a series of free lectures on "Electricity and Magnetism." They are delivered every Saturday night at the Museum of Natural History, Seventy-seventh street and Eighth avenue, New York city. The first lecture was given on January 7. The subjects for the lectures on the successive Saturdays beginning January 21 and ending February 25 are: "Statical Electrical Machines," "Current Electricity; Effects Within the Current," "Current Effects Without the Current," "Current Inductive Effects," "Thermoelectricity; Wireless Telegraphy" and "Rœntgen and Becquerel Rays." Besides experiments the lectures are illustrated by stereopticon views.

ELECTRICAL SECURITIES.

The slightly increasing activity in the stock market at the end of last week led many to believe that a start was to be made in the long-predicted January boom. While this hope seems hardly to be fulfilled, in even conservative quarters, the general feeling is confident and up-lifting. The continued ease in the money market, which has been a potent factor in the determination of speculative tendencies for some time past, gives rise to the belief that easy rates will prevail for some time to come. The fact that from now on considerable money will flow to financial districts from the interior of the country strengthens this opinion.

It seems quite probable that an early settlement of the Northern Securities case will result in a balancing of railway interests, while new and important alliances and deals will open the way for a great deal of new construction. This latter is anxiously awaited by a number of industries, which have been counting on such a source for their early-year prosperity.

Reports of exports for December are disappointing, in that they show a considerable decrease over exports for the same period last year in almost every staple line. There are reports of large increases in pig-iron production for December. For this month the production was larger than that of any other month in 1904, and this total compares favorably with the best record for the same period in any other year.

ELECTRICAL SECURITIES FOR THE WEEK ENDING JANUARY 14.

New York:	*Closing.*
Brooklyn Rapid Transit	62⅛
Consolidated Gas	198¼
General Electric	188¾
Interborough Rapid Transit	190½
Kings County Electric	200
Manhattan Elevated	170¼
Metropolitan Street Railway	117⅛
New York & New Jersey Telephone	165
Westinghouse Manufacturing Company	187

The annual meeting of Brooklyn Rapid Transit Company stockholders will be held January 27, at 12 M. Books closed January 16, and will remain closed until the final adjournment of the meeting.

It is officially stated that the business of the Westinghouse Electric and Manufacturing Company is showing a steady increase, and the management expects that 1905 will be an excellent business year.

Boston:	*Closing.*
American Telephone and Telegraph	145½
Edison Electric Illuminating	250½
Massachusetts Electric	58
New England Telephone	139
Western Telephone and Telegraph preferred	99

The directors of the Edison Electric Illuminating Company have declared a regular quarterly dividend of 2½ per cent, payable February 1 to stock of record January 14. Books do not close.

Philadelphia:	*Closing.*
Electric Company of America	11⅛
Electric Storage Battery common	77½
Electric Storage Battery preferred	77½
Philadelphia Electric	10⅛
Philadelphia Rapid Transit	18¾
United Gas Improvement	109⅜

The directors of the Electric Company of America have declared a semi-annual dividend of 35 cents per share, a rate of 7 per cent per annum. This is an increase, the rate since 1902 having been 6 per cent per annum. This dividend is payable January 31 to stockholders of record January 20. Books will remain closed from January 20 to February 1.

Chicago:	*Closing.*
Chicago Telephone	140
Chicago Edison Light	168
Metropolitan Elevated preferred	60
National Carbon common	40½
National Carbon preferred	113
Union Traction common	11¾
Union Traction preferred	46

The annual meeting of the South Side Elevated will be held January 26. The record of passengers carried for the year indicates that the gross receipts for 1904 will show a decrease of about $100,000. Gross receipts for 1903 were $1,679,310, and the balance added to surplus $121,943.

The annual meeting of the Northwestern Elevated will be held January 25. It is anticipated that the gross earnings for the year will be about $1,600,000, as the company carried an increase of 800,000 passengers during 1904.

It is stated that National Carbon annual earnings are about the same as last year, when $141,014 was added to the surplus.

NEW INCORPORATIONS.

ALLEGHENY, PA.—Fremont Light Company. $5,000.

McKEESPORT, PA.—Tube City Light Company. $5,000.

GRANDVIEW, TEX.—Head Telephone Company. $20,000.

WILKINSBURG, PA.—Wilkinsburg Light Company. $5,000.

NORTH LIBERTY, OHIO—Union Telephone Company. $5,000.

MONTPELIER, MISS.—Clay County Telephone Company. $1,000.

CONNELLSVILLE, PA.—Interstate Electric Company. $5,000.

QUINCY, ILL.—East St. Louis & Edwardsville Interurban. $400,000.

TROY, PA.—Troy Electric Light, Heat and Power Company. $10,500.

THREE RIVERS, MICH.—Three Rivers Telephone Company. $35,000.

MACY, IND.—Macy Telephone Company. Increased from $2,000 to $10,000.

HOPEDALE, ILL.—Farmers' Telephone Company. Increased to $20,000.

LEBANON, PA.—Lebanon County Light, Heat and Fuel Company. $25,000.

McCOMB CITY, MISS.—McComb City Electric Light and Power Company. $50,000.

WHEELING, W. VA.—Belmont Telephone Company. Increased from $75,000 to $150,000.

ROCK ISLAND, ILL.—People's Power Company. Increased from $600,000 to $1,000,000.

BRADDOCK, PA.—Colonial Light Company. $5,000. Incorporators: J. G. Splane and others.

LINCOLN, NEB.—The Central Telephone Company, Broken Bow. Increased from $35,000 to $100,000.

HARRISBURG, ILL.—The Harrisburg Water, Light and Power Company. Increased from $15,000 to $25,000.

ST. PAUL, MINN.—Shakopee Telephone Company. $50,000. Incorporators: J. B. Reis and H. P. Fischer.

CHICAGO, ILL.—Georgetown Electric Company. $15,000. Incorporators: W. F. Brugman, A. M. Searle and C. C. Travis.

LENA, ILL.—Howardsville Telephone Company. $2,500. Incorporators: George W. Davis, F. A. Howard, Edward Fisher.

ROCHESTER, N. Y.—Churchville Telephone Company. $5,000. Incorporators: William L. Ormrod, G. M. Colburn and E. A. Brower.

NEW YORK, N. Y.—Wireless Telegraph Exploitation Company. $10,000. Directors: J. R. Taylor, J. L. Lotsch, R. M. Dyer, New York.

KENOSHA, WIS.—Kenosha & Lake Geneva Railway Company. To build an electric railway from Kenosha through the lake regions. $25,000.

PETERSBURG, ILL.—The Petersburg Telephone Company. $20,000. Incorporators: John S. Hurie, R. A. Kelly and Richard Waldrich.

BELGRADE, MINN.—The Commercial Telegraph Company. $50,000. Incorporators: C. Bogerding, John F. Chisholm and A. Ridgeway.

GUTHRIE, OKLA.—Citizen's Gaslight, Heat and Power Company. $100,000. Incorporators: E. E. Hull, C. C. Roberts and J. R. Ruckles.

CADOTT, WIS.—Cadott Light and Power Company. $4,000. Incorporators: R. B. Cunningham, J. A. McGillivray, H. W. Frasl and six others.

KENOSHA, WIS.—Park City Electric Railway Company. $25,000. Incorporators: John M. Kehlor, Chester D. Barnes and Levi C. Graves.

OMAHA, NEB.—The Baxter Springs Electric Power Company. $30,000. Incorporators: E. T. McCarthy, R. W. Bailey and H. E. O'Neill, of Omaha.

NASHVILLE, TENN.—Rand Power Company. $175,000. Incorporators: H. C. Hicks, C. J. Sawyer, W. R. Hicks, S. M. Leath and R. Rutherford.

SAN FRANCISCO, CAL.—Culiacan Electric Company. $300,000. Incorporators: Isidor Gutte, Sidney Sprout, F. G. Brane, Henry Eickhoff and Henry Hacke.

ENGLISH, IND.—Crawford County Telephone Company. $2,000. Directors: John F. Zimmerman, Fred Reasor, George W. Flick, Lee King, Charles H. Denbo.

ALBANY, N. Y.—Orange County Lighting Company, Middletown. $100,000. Directors: H. N. Jackson, Percy Ingalls, Newark, N. J.; T. B. Reeve, Middletown.

LORAIN, OHIO—The West Side Street Railway. $10,000. Incorporators: W. B. Thompson, Orville Root, William Scher, R. Thew, F. W. Pierce, R. G. Nichols and W. N. Little.

CAMDEN, N. J.—Mexican-American Power Company. To generate electricity for light, power, etc. $1,500,000. Incorporators: Joel H. De Victor, G. Stewart Simons, B. Harvey Welch.

MINERAL WELLS, TEX.—Mineral Wells Electric Power and Heating Company. $50,000. Incorporators: D. G. Galbraith, of Mineral Wells; William D. Williams, of Fort Worth, Tex.

NASHVILLE, TENN.—The Paris Telephone Company. $25,000. Incorporators: John B. Thomason, C. P. Hudson, George H. Trevathan, A. L. E. Morton, F. N. Fisher, J. G. Warren and C. D. McGreer.

PORTLAND, ME.—Northwestern Power Company. To supply all kinds of power. $10,000,000. President, J. C. Rice, Boston; treasurer, C. M. Drummond, Portland; clerk, J. H. Drummond, Portland.

PEORIA, ILL.—Springfield, Lincoln, Bloomington, Pekin & Peoria Electric Railway Company. Changed to Springfield & Northwestern Railway Company, and capital increased from $300,000 to $900,000.

SHANNOPIN, PA.—Hopewell Independent Telephone Company. $5,000. Directors: George M. McConnell, Alexander P. Morrow, John Morrow, Joseph L. Cook, New Sheffield; James Gilmore, Ethel Landing.

HAMMONTON, N. J.—Hammonton Electric Light Company, to generate and distribute electric current for light, heat and power. $50,000. Incorporators: H. B. Woodman, C. E. Starr and F. P. Reed, Hammonton, N. J.

JERSEY CITY, N. J.—Bergen County Telephone Company, to construct and operate telephone line in county of Bergen. $5,000. Incorporators: John F. Trumbull, Bound Brook, N. J.; Edward H. Hoos and Spencer Weart, Jersey City.

CHARLESTON, W. VA.—Winfield, Buffalo & Gallipolis Telephone Company. $5,000. Incorporators: E. B. Hanson, L. Quickle, S. C. Handley, Charles Harris and R. E. Black, of Buffalo, W. Va., and G. E. Stainer and M. V. Brown, of Pliny.

FORT WAYNE, IND.—Fort Wayne & Northern Traction Company. To build an electric line connecting Auburn, Waterloo, Fremont and Angola and points further north. $10,000. Directors: F. H. Cutshall, H. E. Vondermark, J. W. Wessel, Jr., F. H. Schmidt and F. C. Baade, all of Fort Wayne.

PORTLAND, ME.—Railway and Light Securities Company. Capital, $2,200,000. President, R. A. Jackson, Boston; treasurer, C. M. Drummond, Portland; directors, as above named, J. H. Drummond, Portland; J. J. Storrow and W. Endicott, Jr., Boston; Russell Robb and S. Buttrick, Concord, Mass.

INDIANAPOLIS, IND.—Central Electric Traction Company. To build a line through Miami, Fulton, Marshall and St. Joseph counties, connecting the cities of Plymouth, Peru, Rochester and South Bend. $25,000. Directors: J. O. Cole, Jerome Herff, Harry T. Masters, Albert C. Bearss and B. E. Wallace, all of Peru.

ELECTRIC RAILWAYS.

KEOKUK, IOWA—An electric railway line is projected to St. Francisville, Mo.

WHEELING, W. VA.—The city council has granted a franchise to the Pan Handle Traction Company.

CARLISLE, PA.—An electric railway will be built from Mt. Holly, Cumberland County, to Gettysburg.

CHARLESTON, S. C.—The city council of Charleston has granted a franchise to the Charleston & Summerville Electric Railway Company.

CINCINNATI, OHIO—The proposed elevated road between Cincinnati and Norwood will be operated by electricity within the corporation limits.

FORT SMITH, ARK.—The Fort Smith Electric Street Railway Company will expend about $180,000 in improvements, including a new power-house.

ONEIDA, N. Y.—It has been reported that the Oneida trolley line will be extended through Verona to connect with the Mohawk Valley line at Rome.

WEBSTER, MASS.—The Consolidated Railway Company has completed a deal for a site for a brick substation in Webster, and the structure will be erected as soon as the weather will permit.

MILWAUKEE, WIS.—Engineers are at work surveying a right of way for the Milwaukee Street Railway Company from Waukesha to Oconomowoc. Construction work on the extension will begin in the spring.

ST. JOSEPH, MO.—The county court has granted a franchise to the Union Terminal Railway Company for the construction of a line as a continuation of existing lines, from the stockyards to lake Contrary.

HUNTINGTON, IND.—The county commissioners have granted a franchise to the Interstate Interurban Company, which purposes to build between Marion, Ind., and Lima, Ohio, and to have the road completed by May 1, 1906.

NEW HARTFORD, CT.—Thomaston citizens will present a petition to the legislature for a charter for the construction of an electric railway from Thomaston to Waterville, a distance of seven miles, to connect with the Waterbury line.

OMAHA, NEB.—The county commissioners have granted a perpetual franchise to the Omaha, Lincoln & Beatrice railway to construct an electric line from Omaha to Beatrice, by way of Lincoln, and a branch line from Omaha to Fremont.

PORTLAND, ORE.—An ordinance has been introduced before the council granting a franchise to the Oregon Traction Company to lay tracks along certain streets in Portland to enable terminal facilities to be secured for an electric line to Hillsboro and Forest Grove.

SAN DIEGO, CAL.—The San Diego city council has granted an extension for one year of the franchise given to the San Diego Eastern Railway Company several years ago. A committee representing the directors is now looking after details of financing the railroad.

INDIANAPOLIS, IND.—The Dayton & Muncie Traction Company, now operating between Greenville, Ohio, and Farmland, Ind., and which proposes to run cars from Muncie to Dayton, Ohio, announces that it will have cars running into Muncie some time in February, at the latest.

SOUTH BEND, IND.—Work on an electric line between Lagrange and Shipsshewanna, Ind., progressed rapidly until the weather interfered. Work will be continued next spring. The company intends to build a spur to Lake Wawassee, to connect with Milford Junction and Syracuse, Ind.

FAIRMONT, W. VA.—A meeting of the stockholders of the Fairmont & Clarksburg Traction Company was held recently in Fairmont, when officers and directors were elected for the ensuing year. The company was bonded at $1,200,000, the bonds to be handled by Harvey Fisk & Sons, New York. An extension of several miles will be made to the lines the coming year.

OTTAWA, OHIO—The Ottawa village council has granted a franchise to the Lima Traction Company for the construction of a traction line through the town, connecting Lima and Toledo. Assurance is given that work on the new line will be begun as soon as the weather will permit.

MONTGOMERY, ALA.—Massey Wilson and his associates have been granted a franchise by the board of revenue of Montgomery County to construct, operate and maintain a street-car system on the extension of Madison avenue, recently opened by the Capitol Heights Development Company.

HIGH POINT, N. C.—The proposed interurban line connecting High Point, Greensboro and Winston-Salem appears to be a certainty, and it is thought that arrangements can be completed to have the work commence within ninety days. R. H. and R. A. Wheeler, of High Point, are interested.

HOUSTON, TEX.—A company has been formed to construct an electric railway between San Marcos and Luling, and the work of securing assistance from citizens along the line is in progress. The line will start at San Marcos and run through several towns *en route*, among them Martindale and Fentress.

ASHLAND, PA.—The Mahanoy City & Tamaqua Street Railway Company has received its charter from the state for the building and operating of a line between the two towns named. The company is headed by E. M. B. Shepp, president, and is capitalized at $60,000. Work will be commenced early in the spring.

TAMPA, FLA.—The Tampa city council has granted a franchise for the construction of another street railway, which covers the main streets in the eastern portion of the town, and then runs to Ybor City and Sulphur Springs. The projectors of the new road are T. W. Smith, C. E. Ball, W. B. Gray and George C. Warren.

MINEOLA, N. Y.—The Nassau County board of supervisors has granted an extension of time to the Glen Cove Railroad Company on its franchise to construct and operate a trolley line in Glen Cove. The company is given until June 1 next in which to begin work and must file a surety company bond as an evidence of good faith.

RENO, NEV.—The new towns of Fallen and Hazen, in Churchill County, will be connected by an electric railroad. The route has already been surveyed, and a company consisting of Nevada and San Francisco capitalists has raised $240,000 with which to build the road. The power will be supplied by an electric plant on the Truckee river.

OTTAWA, ONTARIO—The Grand Trunk Railway Company is considering the installation of electric locomotives in the Sarnia (Ontario) tunnel under the St. Clair river. The proposed change will necessitate an outlay of between $300,000 and $400,000. There will be required a power plant, storage battery system, third rail and four electric locomotives.

MISSOULA, MONT.—Preparatory work for constructing the Amador railway up Cedar creek, between Iron Mountain, on the Couer d'Alene branch of the Northern Pacific, and the Amador mining property, has been completed, and building is to begin as early as the weather permits. Ample water-power facilities already have been developed for operating the road.

SOUTH HAVEN, MICH.—A franchise for an electric railroad has been granted to C. W. Williams, of South Haven; George Bardeen, of Otsego, and S. J. Dunkley, of Kalamazoo. They must have cars running by July to hold the franchise. Extensions are proposed to Kalamazoo and Saugatuck, which will give South Haven a direct line with Detroit and Grand Rapids.

LAKE PROVIDENCE, LA.—The Lake Providence & Gouldsboro Railroad Company, Limited, a local company, has contracted with A. B. Sanders, of Shreveport, La., for the immediate construction of two miles of electric railway through the town of Lake Providence. This line will go through the business part of the town, thence through Gouldsboro, a new addition to the

town of Lake Providence. Mr. Sanders has placed his order for the material, and will build at the same time for the town a complete waterworks and electric light system.

BOSTON, MASS.—At the annual meeting of the stockholders of the Boston Elevated Railway Company the following directors were reelected: Frederick Ayer, William A. Bancroft, John J. Bright, Samuel Carr, T. Jefferson Coolidge, Jr., Francis H. Peabody, James Phillips, Jr., James M. Prendergast, Nehemiah W. Rice, Quincy A. Shaw, Jr., William S. Spaulding, Walter S. Swan and Robert Winsor.

SPRINGFIELD, MO.—A deal has been consummated whereby the control of the stock of the street railways of Springfield passes into the hands of local capitalists, and it is probable that the various lines will be merged into one system. The holdings of G. W. Parker, R. C. Kerens, S. W. Fordyce and Moses Rumsey, all of St. Louis, have been purchased by the local capitalists, the consideration being $270,000.

GRAND JUNCTION, COL.—At a regular meeting of the Grand Junction city council George Smith was granted a franchise to construct an electric railroad through the streets of Grand Junction, the work on same to commence within ninety days after the passage of the ordinance. Smith has in view an electric line to traverse the entire Grand valley, from Palisade, ten miles east of this city, to Fruita, twelve miles west.

NEW ORLEANS, LA.—Judge Lanning, of the United States Circuit Court, appointed, on January 4, E. C. Foster, of New Orleans, La., receiver for the New Orleans Railway Company, which controls all the street railway lines in New Orleans. This is the result of proceedings brought by the New York Security and Trust Company to foreclose the $2,500,000 mortgage which it holds in the property of the trolley corporation.

CHATTANOOGA, TENN.—Steps have been taken by those interested in the Cleveland-Ducktown Interurban Railway to make the preliminary survey for the proposed line from the Chickamauga Park line of the Rapid Transit Company, at the army post, to Ringgold, Ga., and thence to Catoosa Springs. The company is to be incorporated with an authorized capital stock of $300,000, which will be increased to $2,000,000.

CLARKSBURG, W. VA.—The Clarksburg & Weston Traction Company, of Clarksburg, has been chartered to construct and operate an electric railway between the city of Clarksburg and the town of Weston. The authorized capital stock is $25,000. The incoporators are Humphrey Brohard, of Flemington; Sylvester G. Monroe, of Lost Creek; Frank B. Haymaker, Charles C. Fitiro and Wyckiff M. Conaway, of Clarksburg.

BOSTON, MASS.—The Taunton & Buzzards Bay and Taunton & Pawtucket street railway companies, successor companies to the Middleboro, Wareham & Buzzards Bay and the Bristol County street railway companies, have applied to the railroad commissioners for approval of capital stock. The capital of the Taunton & Buzzards Bay Street Railway Company is fixed at $225,000, and that of the Taunton & Pawtucket Street Railway Company at $200,000.

ST. LOUIS, MO.—Articles of incorporation have been granted at Springfield, Ill., to the Granite City, St. Louis & Eastern Belt Railroad Company. The incorporators and first board of directors are F. G., H. F. and William F. Niedringhaus, of St. Louis, and W. H. Hanlon and C. F. Stelzel, of Granite City. The company proposes to construct a few switches about the National Enameling and Stamping Company's plant at Granite City for convenience in handling the products of the establishment. The principal office is to be in Granite City.

COLUMBUS, OHIO—The Columbus, New Albany & Johnstown Traction Company has filed papers in the secretary of state's office increasing its capital stock from $200,000 to $600,000, of which $200,000 is preferred stock and $400,000 common stock. This was determined upon at its recent annual meeting at which the following were selected as the board of directors: George B. Cox, of Cincinnati; Daniel J. Ryan, W. D. Brickell, H. B. Rusler, of Youngstown; L. P. Stephens and Charles E. Carter, of Columbus. The board organized by the election of these officers: president, W. D. Brickell; vice-president and general counsel, D. J. Ryan; secretary and treasurer, L. P. Stephens.

INDIANAPOLIS, IND.—A fifty-year franchise has been granted the Muncie & New Castle Traction Company by the Delaware County commissioners. The road runs from Muncie to New Castle. A feature of the franchise is the requirement that cars be stopped at every cross-road in the county at least once in every two hours, and that the company construct and maintain a new roadway wherever it uses a public highway. The new line will connect with the Union Traction Company's local street-car system at the southern extremity of the Congerville line.

CONNELLSVILLE, PA.—Right of way for the extension of the West Penn Railway Company from Leckrone to Jacob's Creek, seventeen and one-half miles, has been secured. Construction will begin in the spring. The proposed line is another step in the direction of West Virginia, where ultimately the West Penn system will connect with lines touching Morgantown, Fairmont, Clarksburg, Parkersburg and Wheeling. The route passes through all the new coal and coke towns. The road is generally known as the Pittsburg, McKeesport & Connellsville Railway Company.

PITTSBURG, PA.—Bids for the construction of fourteen miles of electric railroad between McKeesport and Irwin are to be taken so that work on the new line can be started early in the spring. The line is to be built by the Pittsburg & Westmoreland Electric Railway Company, and by its construction it will be possible for passengers to reach almost every portion of Allegheny and Westmoreland counties from Pittsburg over electric lines. The new road is to be constructed largely on private right of way, and with cement or concrete culverts, and one steel bridge at Irwin.

PORTLAND, ME.—The railroad commissioners have approved the articles of association of the Bridgton Street Railway Company in the town of Bridgton. This company proposes to run a line of railway from the landing of the Sebago Lake, Songo River and Bay of Naples Steamboat Company on Long pond to Bridgton. The incorporators are Charles L. Goodridge, N. L. Goodridge and Llewellyn Barton, of Portland, and Lyman B. Chadbourne and Fred C. Knight, of Bridgton. The proposed road would be about one and one-half miles long and the capital stock is placed at $6,000.

MEMPHIS, TENN.—Notice has been given by the Atlanta & Gulf Railroad Company that it will apply for a charter in Georgia to build a line 400 miles long from Atlanta to the gulf. The southwestern terminus has not yet been decided upon, both Pensacola and Mobile being mentioned. In Georgia the road will cross Fulton, Campbell, Douglas, Carroll and Heard counties. The application calls for the use of either steam or electric power, or both. Those interested are F. A. Kuhn, Kennon Dearing, R. B. Beedles, T. H. Goodwin, J. J. McClendon, Henderson Hallman, W. P. Powell, Hugh B. Cobb, D. P. Fleishel and J. R. Bradbury, all of Atlanta.

SPOKANE, WASH.—The Spokane Power and Transportation Company has elected its officers for the coming year, as follows: James Cleveland, president; John Condron, vice-president; George S. Richey, second vice-president; John Gray superintendent and general manager; Jesse M. Fyfe, secretary and treasurer. The directors are James Cleveland, George S. Richey, John Gray, John Condron, T. P. Reardon, W. Boyd Block and E. U. Engle. The Spokane Power and Transportation Company has plans for the construction of an electric road from Spokane to Crystal City, in the Big Bend country, and touching the small towns between those places.

READING, PA.—The lease and agreement of the Adamstown & Mohnsville Electric Railway Company to the United Traction Company has been placed on record in the recorder's office. The latter company leases the road for 999 years, beginning January 1, 1905, and ending January 1, 2904. The lessee is to pay quarterly to the lessor thirty-seven and one-half per cent of the gross receipts until the annual gross receipts shall reach $25,000, all over $25,000 to be retained by the lessee, and all taxes and interest on bonds are to be paid by the lessor. The maximum rate of fare shall be one and one-half cents per mile, except excursion rates, which shall be at the discretion of the lessee. When this lease expires the lessee shall have the right or option to purchase the road for $75,000, subject to the mortgage bonds then outstanding, not exceeding $75,000.

TELEPHONE AND TELEGRAPH.

LITTLE FALLS, N. Y.—The Bell Telephone Company is constructing a line between Little Falls and Middleville.

TROY, N. Y.—The Commercial Union Telephone Company is about to make extensive improvements to its exchange in Upper Troy.

DE SMET, S. D.—The business of the De Smet system has grown to such an extent that it is necessary to install a much larger switchboard.

PASCO, WASH.—Material is on the ground at Pasco for a telephone line to Two Rivers, a new town building about eight miles south of the Snake river.

NEWARK, N. J.—The Chester Local Telephone Company is making preparations to extend its line through to Parker, and possibly from there to Fairmount.

GREAT FALLS, MONT.—The Cascade County Rural Telephone Company has completed a line from Great Falls to Black Butte, a distance of about twenty-five miles.

BIRMINGHAM, ALA.—Poles are being laid along the route of a new telephone system to connect Jeff, Wooley Springs, Monrovia and other rural communities with the telephone system of Huntsville. The new system will be completed at an early date.

FARGO, N. D.—The stockholders of the Red River Telephone Company have elected officers for the ensuing year, as follows: president, P. H. Lamb; vice-president, L. H. Baker; secretary and treasurer, Leslie Welter. Plans for extensions were considered.

DODGE CITY, KAN.—The Dodge City Telephone Company is extending its line to Ford City and thence to Bucklin on the Rock Island. With the line owned by the farmers in the southern part of the county this forms a network of lines covering nearly the whole of the southwest part of Kansas.

PORTLAND, ME.—At the annual meeting of the Atlantic Telegraph Company the following directors were elected: Nathan Pratt, John M. Halligan, John J. Hogan, all of Lowell, Mass.; Philip J. Deering, Howard Winslow, of Portland. John J. Hogan was elected treasurer of the company, and Howard Winslow, clerk.

WHEELING, W. VA.—The following board of directors has been elected by the stockholders of the Belmont Telephone Company: Henry Schmulbach, Dr. Andrew Heinlein, Charles J. Heinlein, J. W. Dondna, C. L. Weems, Frank M. Roberts and J. C. Dent. Plans were discussed for the general extension of the lines of the Belmont company.

SPOKANE, WASH.—George B. Bush, manager of the Pacific States Telephone and Telegraph Company, has announced that during 1905 his company expects to put in from 500 to 600 party lines within a radius of fifteen miles from Spokane. Six hundred miles of wire will be needed and forty to fifty men will be employed in construction. The cost will be $25,000.

CLIFTON SPRINGS, N. Y.—W. H. Burke, of Clifton Springs, and W. C. Ellis, of Shortsville, who have been interested in several telephone companies operating in Ontario County, have sold their interests to the Long-Distance Inter-Ocean Telephone Company, of Buffalo. The company most seriously affected by this sale will be the Clifton Springs Telephone Company, which has been operated and controlled by them.

LYNCHBURG, VA.—The Lynchburg common council has approved the proposed franchise for the Bell Telephone Company, which is intended to be operative thirty years. The company purposes to install a plant costing not less than $100,000, and to make Lynchburg a distributing centre for long-distance service between the north, west and south. The local company's plant was purchased recently by the Bell company.

OGDEN, UTAH—The Rocky Mountain Bell Telephone Company announces improvements which it is preparing to make at once to its local plant. The company now has 2,000 subscribers in Ogden. A new modern fireproof building is to be erected in the rear of the present one, twenty-eight by seventy feet, two stories and basement. In this new building will be installed a modern switchboard costing $24,000, which will more than double the capacity of the plant. The new building itself will cost in the neighborhood of $15,000.

MILWAUKEE, WIS.—A mortgage for $500,000 on the property of the Badger Telephone and Telegraph Company to the Wisconsin Fidelity Trust and Safe Deposit Company has been filed with the register of deeds. The mortgage is given in consideration of 1,000 bonds in the amount of $500 each, which will be issued by the company in the future. The rate of interest on these bonds is to be five per cent. The mortgage is signed by Frank M. Fish and John K. Fish, respectively, president and secretary of the Badger Telephone and Telegraph Company.

LOWVILLE, N. Y.—The annual meeting of the stockholders of the Black River Telephone Company was held recently, and the following board of directors was elected: Charles W. Pratt, S. C. Capron, Boonville; George R. Fuller, Fred W. Zoller, Rochester; Charles H. Poole, T. Harvey Ferris, Utica, and John J. Domser, Lowville. The board of directors elected the following officers: president, Charles W. Pratt, Boonville; vice-president, George R. Fuller, Rochester; treasurer, Charles H. Poole, Utica; secretary, S. C. Capron, Boonville; manager and assistant secretary, John J. Domser, Lowville.

ST. JOSEPH, MO.—St. Joseph and Cameron are now connected by three telephone lines. The Funston Long-Distance Telephone Company opened the third line on January 4, when its wires were connected with the central office of the Citizens' Telephone Company. The line is forty miles in length. It follows the right of way of the Burlington to Cameron. The line has also been connected with the Cameron exchange. About 1,500 subscribers, including the Cameron exchange, will be accommodated. Among the towns reached by the company are Stewartsville, Osborn, Hemple and Saxton. J. G. Funston, superintendent of the Citizens' Telephone Company, is secretary and general manager of the Funston company. E. B. Funston, of Racine, Wis., is its president.

NEW COMPANIES.

CAMDEN, N. J.—F. R. Hansell, Joseph F. Cotter and George H. B. Martin have organized the Martin & Hart Motor Company, with a capital of $200,000.

SPRINGFIELD, ILL.—The Exmoor Battery Company, organized in Arizona with a capital of $150,000, has been incorporated in Illinois with a $10,000 capital.

MILWAUKEE, WIS.—The Herman Andrae Electrical Company has been organized with a capital of $10,000, by Herman Andrae, Herman Schmidt and Jacob Tellier.

JERSEY CITY, N. J.—The Rock Island Battery Company, with a capital of $75,000, has been incorporated by Louis B. Dailey, B. Stafford Mantz and Joseph M. Mitchell.

COLUMBUS, OHIO—The Marshall Electric Company, of Cincinnati, has been incorporated by N. L. Keelen, Fred L. Hoffman, A. K. Hoffman, E. L. Langerman and K. Borman. The company is capitalized at $15,000, and will make and sell electric appliances.

INDIANAPOLIS, IND.—The Tritt Electric Company, of South Bend, Ind., has filed articles of incorporation. The object of the company, which is capitalized at $100,000, is to manufacture electric automobiles. The directors are Burleigh E. Tritt, Daniel M. Calvert, Walter B. Pershing, Edgar R. Miller and Charles M. Kreighbaum.

WILMINGTON, N. C.—The Southern Electric Company, of Wilmington, N. C., recently chartered by the secretary of state with a paid-in capital stock of $4,000, to do a general electrical business, has organized by the election of the following officers: president, J. O. Brock; secretary and treasurer, John Hall. The company will deal in mechanical and electrical supplies, doing general construction work and installing electric, gas and other lighting plants.

INDUSTRIAL ITEMS.

POWELL & COLNE, Bowling Green Building, New York city, are distributing a pamphlet describing the Tropenas converter steel process.

THE POPE MANUFACTURING COMPANY, Hartford, Ct., is distributing a catalogue describing and illustrating Pope Hartford automobiles.

THE EWING-MERKLE ELECTRIC COMPANY, St. Louis, Mo., is extending to the electrical field its greetings for 1905, in the form of a unique colored folder bearing a very bizarre design.

THE STUART-HOWLAND COMPANY, Boston, Mass., is furnishing its patrons with a neat calendar. This has a wide red border surrounding a photograph of the company's place of business in Boston.

THE BRISTOL COMPANY, Waterbury, Ct., has been awarded a gold medal on its exhibit of recording instruments in group 71, by the Universal Exposition, St. Louis, 1904. A medal and diploma for this award are shortly to be issued by the exposition company.

McLEOD, WARD & COMPANY, 27 Thames street, New York city, are distributing a handsome calendar for the year 1905. The illustrations on this calendar set forth about fifteen of the celebrated Kinsman specialties for stand and desk lighting of every description.

THE ELECTRODYNAMIC COMPANY, Bayonne, N. J., is distributing a number of circulars illustrating and describing the new "Interpole" variable-speed motor. Circular No. 1 deals entirely with the construction and characteristics of the motor, and circular No. 2 and circular No. 3 illustrate the application of the "Interpole" motors to machine tool driving.

THE AMERICAN ELECTRIC TELEPHONE COMPANY, 36 West Jackson Boulevard, Chicago, Ill., has recently shipped an additional section of central-energy switchboard equipment to Jackson, Tenn. The Jackson exchange now has an immediate capacity for 1,260 lines, which represents a fifty per cent increase over the original installation. Several increases have been made since the board was installed a number of years ago.

THE BRUCE-MERIAM-ABBOTT COMPANY, Cleveland, Ohio, has been incorporated and will engage in the manufacture of gas and gasoline engines at Fall and Centre streets. The new company is the consolidation of the Meriam-Abbott Company, of Cleveland, builder of vertical-twin-cylinder engines and electric lighting plants, and the Bruce Company, of the same city, builder of the Bruce-Collins automatic power and marine engines. The office of the company is at 8-12 Columbus street.

THE HOLTZER-CABOT ELECTRIC COMPANY, Brookline, Mass., is the subject of a very interesting article in the Brookline *Chronicle* of December 31, 1904. In addition to considerable historical and descriptive matter, there are a number of well-executed half-tone plates. Among the illustrations are a portrait of Mr. Charles W. Holtzer, president, a view of the Brookline works and one of the Boston works, and group views of the executive and engineering staff and of the foremen and sub-foremen of the company.

THE F. W. BRAUN COMPANY, Los Angeles, Cal., has been awarded gold medals by the judges of the St. Louis World's Fair, covering practically its entire line of improved apparatus and appliances for assayers, metallurgists and chemists. The exhibit was arranged in three groups, and a gold medal was secured for each group. Among the medal winners were the following: Cary hydrocarbon burner, "Marvel" crude oil burner, Braun gas burner, Cary furnaces, Braun cupel machine, and a complete line of ore-crushing and pulverizing machines.

THE CLEVELAND ARMATURE WORKS, Cleveland, Ohio, is distributing an attractive catalogue calling attention to its dynamos and motors. In introducing this line of dynamos and motors the company is not attempting to bring about any radical change, either in design or mechanical or electrical construction. The company has grown during the past nine years from a small beginning to one of the largest repair works in America. The experience which it has gained through this repair work has brought it to a knowledge of the strong and weak points of all forms of electrical machinery. For its new line of electrical machinery, therefore, it claims perfect commutation, cool running, high efficiency, substantial construction and interchangeable parts, high quality of insulation, perfect balance and handsome appearance.

THE ELECTRIC CONTROLLER AND SUPPLY COMPANY, Cleveland, Ohio, has placed Mr. George Magalhaes in charge of its eastern office at 136 Liberty street, New York city. Mr. Magalhaes is a graduate of Columbia University, and has been connected with the engineering department of the company for some time. He is thoroughly familiar with the company's products, chief of which are reversing controllers, solenoids, lifting magnets, magnetic switch controllers for reversing or non-reversing motors driving heavy machinery, direct-connected variable-speed motor drive for planers, etc.

MESSRS. GOLDMARK & WALLACE, 67 Cortlandt street, New York city, announce that they will represent the Eck Dynamo and Motor Works in the sale of the latter company's high-grade electrical machinery, consisting of direct-current electric motors in sizes from one-twenty-fourth to twenty horse-power, vertical motors, direct-current generators in capacities of 0.03 to fifteen kilowatts, "Hurricane" direct-current rigid and oscillating fan motors, and special motors and generators to suit the requirements of exceptional cases. Goldmark & Wallace will carry these motors in stock in sizes from one-twelfth to five horse-power.

THE CRESCENT FORGING COMPANY, Pittsburg, Pa., has been organized with a capital stock of $50,000. Its works will be located at Oakmont, a suburb of Pittsburg, and the general offices will be in the Farmers' Bank Building. For the present a forge shop 65 by 150 feet and a machine shop 60 by 100 feet will be erected of steel. A complete power plant, embracing all modern labor-saving appliances, will be installed, and all machinery will be operated electrically by individual motors. The president, Mr. Reuben Miller, Jr., states that he desires catalogues and information from manufacturers in position to furnish any part of this equipment.

JOHN A. ROEBLING'S SONS COMPANY, 117-121 Liberty street, New York city, is distributing an attractive and very practical calendar for 1905. The calendar pad is of large proportions, and the figures are of such dimensions that they may be readily seen at some distance. The illustrations are unique and present a very good idea of the various uses to which the products of the Roebling company may be put. These products include telegraph wire, trolley wire, insulated electrical wires, wire rope for ship and yacht rigging, wire rope for logging, wire rope cableways, wire rope for power transmission, wire rope for mining, elevator rope for office buildings, and suspension-bridge cablework.

THE SCHWERDTLE STAMP COMPANY, 39-41 Cannon street, Bridgeport, Ct., will receive all the assets and assume all the contracts and obligations of the Schwerdtle Stamp Company, 39 Fairfield avenue, and the Bridgeport Stamp Company, 156 Fairfield avenue. The new company has been incorporated under the laws of the state of Connecticut. It has equipped a new factory with increased facilities, including modern machinery and new type, and will be able to handle its growing business more promptly and satisfactorily than ever before. It is the intention to carry a full line of hand stamps, office and factory supplies, such as daters, numbering machines, self-inking stamps, stamp racks, type, pads, inks, steel and stencil letters, figures and metal checks.

THE ATWATER KENT MANUFACTURING WORKS, 112 North Sixth street, Philadelphia, Pa., is placing on the market a new battery switch. This switch is intended for a convenient and durable device, fashioned after larger electrical apparatus. The handle end of the lever is provided with notches to keep the lever in position. The connections are made after the switch has been mounted on the dash. When the connections have been made the switch is covered by the name-plate. This avoids bending the wires after connections are made, in order to screw the switch into place. If it becomes necessary to examine the connections this may be done by simply removing the name-plate. The switch is substantially made, the brass parts being of heavy metal; and the only two holes that are made in the device are in the insulated portion, and these are bushed with brass.